

Proceedings of the
9th International Conference

Sport and Quality of Life 2013



Brno, Masaryk University Campus, Nov. 7-8, 2013

Proceedings of the 9th International Conference Sport and Quality of Life 2013

Všechna práva vyhrazena. Žádná část této elektronické knihy nesmí být reprodukována nebo šířena v papírové, elektronické či jiné podobě bez předchozího písemného souhlasu vykonavatele majetkových práv k dílu, kterého je možno kontaktovat na adrese – Nakladatelství Masarykovy univerzity, Žerotínovo náměstí 9, 601 77 Brno.



The conference was held under the auspices of

Rector of the Masaryk University
South Moravian Region
Czech Kinanthropology Association

<http://conference2013.fsps.muni.cz>

Proceedings of the
9th International Conference

Sport and Quality of Life 2013

Brno, Masaryk University Campus, Nov. 7-8, 2013



SCIENTIFIC COMMITTEE

Anita Hökelmann (Germany)

Damir Knjaz (Croatia)

Andrew M. Lane (Great Britain)

Willy Pieter (Netherlands)

Rado Pišot (Slovenia)

Weimo Zhu (USA)

Jiří Nykodým (Czech Republic)

Vladimír Hellebrandt (Czech Republic)

Michal Charvát (Czech Republic)

Jan Novotný (Czech Republic)

Josef Pavlík (Czech Republic)

Pavel Stejskal (Czech Republic)

Martin Zvonář (Czech Republic)

ORGANIZING COMMITTEE

Martin Zvonář

Michal Vít

Eva Špillingová

Zuzana Sajdlová

REVIEWERS

Weimo Zhu

Andrew M. Lane

Willy Pieter

Zdenko Reguli

Jana Nová

Vladimír Psalman

EDITORS

Martin Zvonář

Zuzana Sajdlová

TECHNICAL EDITOR

Michal Huvar

Petr Líznař

© Masarykova univerzita, 2013

ISBN 978-80-210-6640-3

CONTENTS

BIOMEDICAL ASPECTS OF SPORT

Jaroslav Motýčka, Jan Štastný, Hana Lepková, Miloslav Pašek, Michaela Bátorová
Kinematic and dynamic analysis of swimming 2009-2013.....14

Gabriel P. Fife, David M. O'Sullivan, Willy Pieter
Effects of Taekwondo Footpad Protectors on Resultant Linear Acceleration of an Instrumented Head-form.....25

Renata Vařeková, Ivan Vařeka
Are asthmatic children prone to obesity?.....32

Vít Černý, Kateřina Feitová
Influencing postural stability parameters by means of a power yoga exercise programme for students.....36

Martina Bernaciková, Jaroslava Chovancová, Tomáš Kalina
The cost of running on different surfaces in long distance runners.....43

Dagmar Králová, Jan Novotný, Jana Řezaninová
Kinesio taping effect on biceps brachii muscle strength.....51

Michal Kumstát
A current literature review Actual concepts and contemporary scientific interests in sport nutrition.....59

Ondřej Smolka, Michal Kumstát, Iva Hrnčířiková, Martin Sebera
The effect of caffeine administration on endurance performance using the Borg scale..67

SPORT IN THE PERSPECTIVE OF SOCIAL SCIENCES

Emanuel Hurych
The Spirituality of Movement Activities in the Context of Philosophical Kinanthropology.....74

Aleš Sekot
Physical Activities in Czech Society.....83

Faik Ardahan

The Effect of Participating in Official Recreational Activities on Organizational Citizenship, Organizational and Professional Commitment, Life Satisfaction and Achievement Perception.....97

Pavel Král, Stanislav Tripes, Petr Pirožek

Effectiveness of national sport organizations: Applicability and suitability of approaches to measuring effectiveness in the Czech Republic.....109

David Paar

Socio-economical Differences between Hungarian Sport Consumers.....118

Iveta Šimůnková, Viléma Novotná, Jan Chrudimský

Contribution of gymnastic skills to the educational content of physical literacy in elementary school children and youth.....129

Eva Urbánková, Tomáš Augustýn, Vladimír Jůva

The use of information technology in non-formal education and learning of handball coaches.....138

Renáta Východilová, Věra Večeřová, Zora Svobodová, Radka Štreštková

Methodical Materials for Elimination of Language Barriers in Sports Environment: Sports Terminology.....146

QUANTITATIVE AND QUALITATIVE ANALYSIS OF HUMAN MOVEMENT

Vladimír Süss, Petra Pravečková, Bronislav Kračmar, Petra Matošková

The analysis of one-handed overhead throwing.....156

Pavel Korvas, Tomáš Kalina, Radek Musil

Treadmill walking and overground walking – the comparison of selected characteristics.....164

Gabriela Kavalířová, Věra Knappová

Evaluation and Development of Coordination Abilities by Children with Mental Disability.....175

Petra Matošková, Vladimír Süss, Bronislav Kračmar

Differences in the activation of selected muscles throughout a curve with the use of internal stabilizer in handicapped skiing group LW2.....183

Tomáš Vespalec, Martin Zvonař, Josef Pavlík, Jindřich Pavlík
Balance Abilities of Adult Population in Relation to Their Physical Activity.....190

Pavel Vacenovský, Tomáš Vencúrik
Improvement of reaction time through the one semester course of table tennis for non-athlete students.....200

SAFETY IN PHYSICAL EDUCATION, SPORT AND LEISURE ACTIVITIES

Wojciech J. Cynarski
The traditional art of swordmanship and its application today. A case study of one of the Japanese schools.....209

Willy Pieter
Cerebral Concussions in Young and Adult Athletes: Epidemiology and Mechanisms.....217

Alena Pokorná, Renata Východilová, Hana Vrtělová
Wellness Fit Programme at University Sport Centre department.....224

Ivan Uher, Milena Švedová, Rastislav Feč, Alena Buková
Life style and environment influences on body fat in adolescent's population.....232

Zuzana Tulisová
The working conditions and injuries of students as a source of stress of physical education teachers.....241

AGEING AND PHYSICAL ACTIVITY

Jitka Kopřivová, Zuzana Žecová
The effect of exercise intervention on selected functional abilities of seniors.....250

Viléma Novotná, Iveta Šimůnková, Kristina Svobodová
Movement and psycho-social aspects of gymnastic programs for "Golden Age".....257

Patryk Stecz, Józef Kocur
Physical activity, stress, coping and life satisfaction in patients undergoing total hip replacement.....265

SPORTS TRAINING, PROFESSIONAL SPORT

Andrew Thomas, James Goodwin

The influence of modified warm up on 100 m Freestyle swimming performance.....279

Michal Malák

Manipulation with intensity load of elite cross-country skiers during the pre-season period.....287

Michal Mojžiš, Božena Paugschová

Effects of physical load on the dependence between postural stability and shooting performance in biathlon.....295

Marián Uvaček

The comparison of game performance in beach volleyball at the 2012 Olympic Games in the final men and women matches in the selected game activities.....305

Tomáš Vencúrik, Jiří Nykodým

Heart Rate Response to Game Load of Female Basketball Players in Category U19 and Senior Category.....311

MISCELLANEOUS

Jana Nová

The role of the teaching case studies in the sport management education.....319

Ivan Struhár, Lenka Dovrtělová

Implementation of core stability programme for footballers in middle school aged.....328

Petr Vlček

Discourse on curriculum development in physical education, recent development in Europe.....335

Jaroslav Vrbas

Heart rate changeability in representation lessons of physical rate.....344

Sections:

A g e i n g and physical activity

Key speakers: *Anita Hökelmann* (Otto-von-Guericke-University Magdeburg, Germany), *Henriette Dancs* (The University of West Hungary, Hungary)

B i o m e d i c a l aspects of sport

Key speaker: *Weimo Zhu* (University of Illinois at Urbana-Champaign, USA), *Milan Sedliak* (Faculty of Physical Education and Sports UK, Slovakia)

Q u a n t i t a t i v e and qualitative analysis of human movement

Key speakers: *Rado Pišot* (University of Primorska, Slovenia), *Mike Hughes* (Cardiff Metropolitan University, UK)

S a f e t y in physical education, sport and leisure activities

Key speakers: *Wojciech Cynarski* (Rzeszów University, Poland), *Willy Pieter* (Keimyung University, Korea)

S p o r t in the perspective of social sciences

Key speakers: *Emanuel Hurych* (College of Polytechnics Jihlava, Czech Republic), *Andy Lane* (University of Wolverhampton, Great Britain)

S p o r t s training, professional sport

Key speaker: *Michal Polák* (Czech Anti-Doping Committee, Czech Republic)

WELCOME SPEECH OF THE FACULTY DEAN AND VICE-DEAN FOR SCIENCE AND RESEARCH

Dear Friends and Colleagues,

welcome to Brno at the 9th International conference “Sport and Quality of Life” hosted by the Faculty of Sports Studies, Masaryk University, November 7-8, 2013.

We are proud to welcome our colleagues from countries all over the world at our conference. We have a privilege of assembling a number of leading researchers and scholars who will present the key topics in the field of their scientific activities.

The aim of our conference is to offer the participants a forum for the latest research and both theoretical and applied insight from the field of Sports Science disciplines. Participants will take part in oral and poster presentations.

The conference is held for the first time in the University Campus at Bohunice. Besides the conference, all participants and visitors are invited to the international sport fair “SPORT Life”. Free entrance to the fair is covered within the conference fee.

We hope that the conference will contribute to exchange of latest research findings and ideas in the area of physical education and their applications to quality of life. We wish you a pleasant stay in Brno.

doc. Mgr. Jiří Nykodým, Ph.D.

Head of Scientific Committee

doc. Mgr. Martin Zvonař, Ph.D.

Head of Organising Committee

BIOMEDICAL ASPECTS OF SPORT

Kinematic and dynamic analysis of swimming 2009-2013

*Jaroslav Motyčka, Jan Šťastný, Hana Lepková, Miloslav Pašek, Michaela Bátorová
Centre of sport activities, Brno University of Technology, Brno, Czech Republic*

Abstract

Centre of sport activities of Brno University of Technology has been successfully involved in kinematic and dynamic analysis of swimming since 2009. A device for speed measuring of rectilinear movement of an object or a person with synchronous video-recording can measure the speed of swimming using two tachographs and it can synchronously record the underwater movement of a swimmer using three camcorders. An immediate evaluation of swimming technique is computerised using the software SwimDataViewer v3.0 proposed by our research team. Since 2009 we have measured and evaluated the recordings of 270 swimmers; most of them have been measured several times a year. After completing the measurements, we printed 1,367 individual recordings of speed and acceleration of swimming in twenty five meter sections. We printed 1,605 video-recordings with errors in swimming technique. We produced a DVD of completed measurements and after the lectures showing the recordings from measurements of national teams we forwarded the printed recordings to the coaches and measured swimmers. Each year, we drew up the tables comparing the highest efficiency of swimming technique achieved by junior and senior national teams of the Czech Republic. The measured values in the tables led to efforts of each measured person to be involved the tables, or to approach the highest efficiency of swimming techniques as closely as possible. Coaches and swimmers were no longer solely interested in the amount of performed kilometres and their evaluation. They started to be also interested in swimming technique because they received our documents (recordings of swimming speed and videos taken underwater by camcorders) and the objective information on the errors and deficiencies in swimming technique of swimmers measured by our research team. This project represents our contribution to how to achieve a major success of national swimming teams of the Czech Republic in European and worldwide competitions.

Keywords: *Speed, analysis, video-recording, efficiency.*

Introduction

In our conference contributions from the years 2009-2013 we introduced and justified a kinematic and dynamic analysis of swimming and we recorded the development and

means of measuring and analyzing the speed of swimming national team of the Czech Republic. This paper brings about some new information and evaluates five-year efforts of our research.

The year 2009 was devoted to the work and development of new, technically sophisticated tachographs, development of structures for mounting of measuring equipment at swimming pools, construction of a trolley with camcorders to record the underwater movement, work with AD and digital camcorders and development of software to synchronize the record of swimming speed with video-recordings from the three camcorders. An important step in research was a solution to synchronizing the video-recording and speed recording from the tachograph in 2006. After development of a new tachograph, the first measurement of national representative team of senior swimmers was carried out in October 19-20, 2009. The years 2010-2013 were devoted to extensive measurements of large national teams, swimming teams of primary schools and sports grammar schools in the Czech Republic, to evaluations of these measurements and transfer of respective conclusions to coaches.

Methods

Upon completion of all administrative and technical requirements, a TACHOGRAPH – a device for measuring the speed of rectilinear movement was registered in the inventions journal of Brno University of Technology (BUT) under the number 2012/178. Equipment for measuring the speed of rectilinear movement of an object or person with synchronous video-recording was registered in the inventions journal of BUT under the number 2012/179. From 2009 to June 2013 the above-mentioned devices measured a total of 270 male and female swimmers from national teams of the Czech Republic (juniors, senior juniors and seniors).

DVD recordings of speed and acceleration were forwarded, as required by the Czech Union of swimming sports, clubs and schools, to coaches and measured swimmers. Coaches, following our consent, copied the recordings on USB Flash disks or DVDs for measured swimmers. The results are discussed with coaches and swimmers who are recommended to eliminate the recorded errors and improve the efficiency of their swimming technique. Each additional measurement verifies how the swimmer was able to bring the respective recommendations into practice. Primary schools and twelve sport grammar schools in the Czech Republic have been given an opportunity to register their top swimmers for each research measurement. For this they require to measure two swimming strokes and for swimmers specializing in medley race they require the measurement of all four swimming strokes. During each measurement, the respective coaches were allowed to immediately track the

swimming speed records and video-recordings from three camcorders on a computer monitor. Measured swimmers can access the recordings immediately after completing the measurement on the computer monitor; these recordings are provided with a commentary on identified errors and shortcomings in their swimming technique. In the supplied video-recordings the swimmers may see the shortcomings in their swimming technique and are familiarised with efficiency, speed and acceleration of their swimming technique. With this immediate feedback, they can start to work on filling the gaps in their swimming technique and thereby increase their swimming efficiency.

Results

Since 2009, the tables have been worked out comparing the highest efficiency of the swimming technique achieved by junior and senior national teams of the Czech Republic. These tables are handed out to all participants of the Czech championship and Swimming Grand Prix in Brno, to coaches and swimmers. These tables are constantly updated according to the highest achieved values of efficiency among all measured representatives of the Czech Republic. The present article includes the tables with the highest efficiency of swimming technique achieved by junior and senior national teams. Notes on the evaluation were added to the tables of measured swimmers as an attachment; these notes are also presented in this article to raise a discussion.

NOTES TO EVALUATION OF TABLES WITH HIGHEST EFFICIENCY OF SWIMMING TECHNIQUE OF CZECH SWIMMERS.

<p>MEAN SPEED ($m \cdot s^{-1}$) - MS</p> $\bar{v} = \frac{\sum_{i=1}^n v_i}{n}$	<p>MS is for each measurement we require the highest possible mean speed approaching the racing speed.</p>
<p>STANDARD DEVIATION($m \cdot s^{-1}$)- SD</p> $s = \sqrt{\frac{\sum_{i=1}^n (v_i - \bar{v})^2}{n}}$	<p>SD is a deviation from the uniform speed that should be as low as possible.</p>

VARIATION COEFFICIENT (%) – VC	VC is calculated from the fraction of standard deviation and mean speed. It is a dimensionless proportional quantity. Due to its large range in each swimming style, it is a very sensitive indicator of swimming technique. The variation coefficient should be as low as possible.
EFFICIENCY OF SWIMMING TECHNIQUE (%) – Ef.	Ef. is calculated from the work performed while swimming. It is work at uniform speed divided by actual work of measured fluctuating speed. In each measured element it should be as close as possible to 100%.

The highest efficiency evaluation of swimming technique of Czech swimmers in 2009-2013

We present the calculated median values of mean speed, variation coefficient, and efficiency that were measured in 2009-2013. To calculate the mean values a pattern of 48 probands – female and 81 probands – man. For crawl was selected 25 male and 13 female, for butterfly was selected 18 male and 12 female, for Backstroke was selected 22 male and 10 female and for breast stroke was selected 16 male and 13 female. For each swimming style an independent sample of probands from the measurement of the Czech team of juniors and seniors was selected.

Tab. 1 Swimming style

Swimming style	Sex	Mean speed (m·s ⁻¹)	Variation coefficient (%)	Efficiency (%)	Standard deviation (m·s ⁻¹)
Crawl	male	1.66	12.57	95.38	0.209
Crawl	female	1.44	14.91	93.81	0.214
Butterfly	male	1.57	19.40	89.73	0.316
Butterfly	female	1.32	23.64	86.09	0.351
Backstroke	male	1.49	13.09	95.165	0.209
Backstroke	female	1.33	14.40	94.20	0.180
Breast stroke	male	1.22	50	58.35	
Breast stroke	female	1.11	42.1	63.51	

Presented theme assured values hold inform the measured swimmers on the achieved level of swimming technique in the Czech Republic; they should provoke each swimmer to not only approach the measured values as close as possible, but also try to overcome them. After many years of training, the majority of measured swimmers are in the phase of creative association. Top-level swimming is due to its complex motoric structure the most demanding sport and belongs among complex motoric skills. Each top-level swimmer, at full concentration, is able to positively change his/her technique. Research measurements give the possibility to find this objectively verified technique, and then to transfer it to race environment.

Tab. 2 Swimming style crawl – male

Name (year of birth), date of measurement	Mean speed ($\text{m}\cdot\text{s}^{-1}$)	Standard deviation ($\text{m}\cdot\text{s}^{-1}$)	Variation coefficient (%)	Efficiency (%)
Senior V. M. (1980), 16/ 5/ 2013	1.86	0.047	2.54	99.80
Senior Junior H. T. (1994), 25/ 10/ 2012	1.76	0.126	7.15	98.49
Junior M. L. (1996), 25/ 10/ 2012	1.51	0.0858	5.67	99.04

Tab. 3 Swimming style crawl – female

Name (year of birth), date of measurement	Mean speed ($\text{m}\cdot\text{s}^{-1}$)	Standard deviation ($\text{m}\cdot\text{s}^{-1}$)	Variation coefficient (%)	Efficiency (%)
Senior P. A. (1992), 2. 12. 2010	1.61	0.062	3.82	99.56
Senior Junior B. J. (1995), 5/ 4/ 2012	1.48	0.144	9.72	97.27
Junior P. M. (1996), 20/ 10/ 2011	1.50	0.0928	6.19	98.86

Tab. 4 Swimming style backstroke – male

Name (year of birth), date of measurement	Mean speed ($\text{m}\cdot\text{s}^{-1}$)	Standard deviation ($\text{m}\cdot\text{s}^{-1}$)	Variation coefficient (%)	Efficiency (%)
Senior V. M. (1980) 16/ 5/ 2013	1.65	0.1132	6.8736	98.60
Senior Junior V.F. (1995), 25/10/2012	1.40	0.1329	9.52	97.36
Junior O.M. (1998), 1/11/2012	1.53	0.1896	12.40	95.64

Tab. 5 Swimming style backstroke – female

Name (year of birth), date of measurement	Mean speed ($\text{m}\cdot\text{s}^{-1}$)	Standard deviation ($\text{m}\cdot\text{s}^{-1}$)	Variation coefficient (%)	Efficiency (%)
Senior V.K. (1989), 22/12/2010	1.35	0.333	6.03	98.80
Senior Junior K. V. (1995),23/2/2012	1.33	0.0970	7.29	98.42
Junior V.P. (1997), 25/10/2012	1.22	0.0778	6.37	98.80

Tab. 6 Swimming style butterfly – male

Name (year of birth), date of measurement	Mean speed ($\text{m}\cdot\text{s}^{-1}$)	Standard deviation ($\text{m}\cdot\text{s}^{-1}$)	Variation coefficient (%)	Efficiency (%)
Senior H. T. (1994) 23/ 5/ 2013	1.63	0.2943	18.08	90.98
Senior Junior H. T. (1994), 25/ 10/ 2012	1.48	0.1887	12.75	95.42
Junior K. D. (1996), 25/ 10/ 2012	1.34	0.149	11.08	96.39

Tab. 7 Swimming style butterfly – female

Name (year of birth), date of measurement	Mean speed (m·s ⁻¹)	Standard deviation (m·s ⁻¹)	Variation coefficient (%)	Efficiency (%)
Senior E. M. (1993), 2/ 12/ 2010	1.45	0.1359	9.34	97.44
Senior Junior K. V. (1995), 23/ 2/ 2012	1.38	0.1749	12.67	95.39
Junior Ch. G.(1997), 25/ 10/ 2012	1.28	0.1481	11.55	96.16

Tab. 8 Swimming style breast stroke – male

Name (year of birth), date of measurement	Mean speed (m·s ⁻¹)	Standard deviation (m·s ⁻¹)	Variation coefficient (%)	Efficiency (%)
Senior B. P. (1991) 23/ 5/ 2013	1.35	0.355	26.30	82.90
Senior Junior T. J. (1995), 13/10/2011	1.18	0.3247	27.52	81.67
Junior M. L. (1996), 25/10/2012	1.16	0.499	43.06	64.05

Tab. 9 Swimming style breast stroke – female

Name (year of birth), date of measurement	Mean speed (m·s ⁻¹)	Standard deviation (m·s ⁻¹)	Variation coefficient (%)	Efficiency (%)
Senior Ch. P. (1986), 25/3/2010	1.00	0.2731	27.31	81.66
Senior Junior S.S. (1995), 25/10/2012	1.13	0.3908	34.45	74.15
Junior K.T. (1998), 31/3/2011	1.12	0.3533	31.55	77.91

The highest efficiency of swimming technique was achieved in crawl with male seniors 99.80 % and 99.56 % with female seniors. The second place is occupied by

a swimming style back stroke with male senior 98.60 % and female senior 98.80 %. It is followed by butterfly with male junior 96.39 % and female senior 97.44 %. The lowest efficiency of swimming technique was achieved in swimming style breaststroke; 82.90 % male senior and female senior 81.66 %. The achieved efficiency of butterfly swimming technique by a junior male cannot be overestimated because the technique of swimming and especially in butterfly is not stable. A joyful promise of efficiency is the achieved value of swimming technique in backstroke with junior female 98.80 %, which paralleled a 24 year-old senior female. Technique of swimming in this swimming style is relatively stable. In a similar way we evaluate the achieved efficiency of swimming technique for each swimmer.

Discussion

A declarative and informative value of presented tables is so extensive that it is impossible to provide a simple and brief evaluation. Let us sum up at least the most important: the tables show the highest achieved efficiency of swimming technique within five years of research measurements of the most powerful male and female swimmers in the Czech Republic. It can be assumed that in the senior category we can expect in the near term (one year) an increase in the efficiency of swimming technique only by tenths or hundredths of percent.

In the category of senior juniors we can expect a large increase in the efficiency of swimming technique in all four swimming strokes because junior swimmers who have already achieved a high efficiency of swimming technique will qualify for this category. We expect major changes in the tables of juniors. As an example a reached efficiency of the swimming style of a younger junior D.V. that was born in 1996 can be presented. On 25th of October this junior reached the efficiency of 96.39 % in butterfly stroke, an older junior H.T. born in 1994 reached an efficiency of 95.42 in the same style, being measured October 25th. It is supported by the fact that coaches in primary schools and sport grammar schools in cooperation with our research team devote a large space to work on swimming technique. Unlike seniors, swimmers of these schools learn a better technique much easier. In junior training sessions the time devoted to teaching the swimming technique at the current level of scientific knowledge leads to the fact that with the same time devoted to training it is possible to reduce the total amount of performed kilometres. This then reduces damaging of not fully developed locomotors system of young swimmers.

This extensive work of our research team gradually yielded positive results in growth of performance of measured swimmers. Coaches and swimmers were no longer solely interested in the amount of performed kilometres and their evaluation

in each training session. They started to be also interested in swimming technique because they received our documents (recordings of swimming speed and video-recordings taken underwater by camcorders) and the information on the errors and deficiencies in their swimming technique. The approach of male and female swimmers to training sessions had changed. It was no longer only mechanical and the so-called endless swimming in indoor pools from here to there. Based on the conclusions of each measurement, all measured swimmers had to think of his/her body position in the water, work of their arms and legs, breathing into the water, minimum time to breath above the surface. With all this, the training sessions in the water became more interesting and the training time seemed to be considerably reduced.

Conclusion

A review of the last five years 2009-2013 is a success for the research team of the Centre of sport activities of Brno University of Technology. The Level of the Czech swimming in recent years goes unquestionably up. The evidence is the success of the senior and junior swimmers at the European and World competitions since 2010. At the European Championships in a short pool (Eindhoven 2010, Szczecin 2011, Chartres 2012), the Czech swimmers are regularly ranked in the final rounds (Martin Verner, Jan Šefl, Petr Bartunek), and they even bring medals from the individual and the relay races (Simon Baumrtová, Petra Chocová, Barbora Závadová, Aneta Pechancová, junior Lucie Svěčená and others). In the “long” pool dominates an aforementioned quartet of swimmers Baumrtová, Závadová, Chocová (final positions at the World Championships in Shanghai 2011, London 2012 Olympic Games, the World Championships in Barcelona 2013) and successful junior Lucie Svěčená (multiple medalist MEJ 2013) significantly gets into awareness of the public, recently the long distance swimmer Jan Micka is one of the biggest junior talents (multiple winner MEJ 2013) and other juniors – such as the swimmer of position race Pavel Janeček, the backstroke swimmer Tereza Grusová, long-distance swimmer Roman Dmytrijev, from the youngest swimmer category there are swimmers such as the breaststroke swimmer Antonín Svěčený, positional race swimmer Marek Osina and other talented swimmers. All of these swimmers were measured by us and the corrections of their swimming technique were recommended and their recent success confirms the success of the transmission from our research into practice.

The team has developed new devices for measuring the speed of rectilinear movement of objects or persons and equipment for measuring the speed using synchronous recording of this movement with camcorders placed underwater; these devices were awarded the title of inventions of Brno University of Technology.

The team has also developed the software to record and evaluate the measurements of speed of movement of measured swimmers in the water. Over a period of five years, in a large extent, the team has measured national swimming teams of the Czech Republic during their preparation for the Olympic Games, junior national teams, swimming teams of sport grammar schools and primary schools in the Czech Republic. The evaluated results of these measurements and the respective conclusions have contributed to an increase in the level of Czech swimming at European and worldwide swimming competitions.

References

Motyška, J.; Šťastný, J.; Lepková, H.; Pašek, M.: Dynamická a kinetická analýza techniky plavání reprezentace ČR 2009/2010. In Optimální působení tělesné zátěže 2010. ISBN: 978-80-7435-076-4.

Motyčka, J.; Lepková, H.; Šťastný, J.; Pašek, M.: Porovnání výsledků měřené techniky plavání juniorské a seniorské reprezentace. In Plavecká lokomoce a zatěžování ve vodě, 2011. s. 57-61. ISBN: 978-80-86317-89-2.

Motyčka, J.; Lepková, H.; Šťastný, J.; Pašek, M.: A brief survey of evaluation of the results measuring the swimming techniques of the junior representation of the Czech republic. In Book of Abstracts. Brno: Masarykova Univerzita, 2011. s. 29-29. ISBN: 978-80-210-5610-7.

Motyška, J.; Šťastný, J.; Lepková, H.; Pašek, M. & Bátorová, M.: Komparace výsledků měření rychlosti plavání seniorské a juniorské reprezentace ČR v letech 2011 a 2012., IN: Pohybové aktivity ve vědě a praxi. Praha FTVS UK: 2013, V tisku, 8 s.

Šťastný, J.; Motyčka, J.: Úvod do vyhodnocení rychlosti a účinnosti plavecké kroulové techniky. In Kondičný trénink v roku 2012. Banská Bystrica: 2012. s. 210-217. ISBN: 978-80-8141-023-9.

Effects of Taekwondo Footpad Protectors on Resultant Linear Acceleration of an Instrumented Head-form

Gabriel P. Fife¹, David M. O'Sullivan¹, Willy Pieter²

¹Department of Physical Education, Chung-Ang University Anseong, Republic of Korea

²College of Physical Education, Keimyung University, Daegu, Republic of Korea

Abstract

The purpose of this study was to investigate the impact attenuation properties of protective taekwondo footpads by evaluating their ability to reduce the peak resultant acceleration (RLA) of an instrumented head-form. A standardized (ASTM F-2397) martial arts headgear striker was used to impart impacts to a 50th Percentile Male Hybrid III Dummy (Hybrid III) head and neck complex. All impacts were imparted with a terminal striking velocity of 5.0 m/s (max - min=5.15-4.75 m/s). Terminal striking velocity was verified by using the time the striker took to pass the photoelectric sensor field. Acceleration data were sampled according to CFC 1000 via a USB connected Compact DAQ chassis (cDAQ-9174, National Instruments). Three different footpad conditions were employed (no footpad, current World Taekwondo Federation approved footpad (8 mm), and a thick footpad (12 mm). The results of this study indicate that the thick footpads (not WTF approved) provided the greatest attenuation of impact from strikes to a protective headgear fitted Hybrid Dummy. Although the WTF-approved pad did provide attenuation properties which yielded satisfactory RLA values (i.e., below passing limits of ASTM F-2397). It is recommended that future studies test more than one protective headgear model, different sizes and other footpad models.

Keywords: taekwondo, footpad, impact, protective headgear, head injury.

Introduction

The most recent report by the International Olympic Committee Medical Board identified taekwondo to be the most injurious sport among all sports at the 2012 London Games, with football coming in second place (Engebretsen et al., 2013). This comes just four years after taekwondo held second place to football during the 2008 Beijing Games (Junge et al., 2009). More taekwondo-specific epidemiology reports of competition-related injuries present a head injury incidence four times higher (9.4/1000 athlete exposures versus 2.3/1000 athlete exposures) than American football over a 15-year period for taekwondo and 16 years for American football (Pieter et al., 2012). These studies highlight the importance of investigating the biomechanical characteristics of

protective taekwondo headgear to better understand the most scientific approach to help decrease the incidence and severity of head injury in this sport through improved protective equipment design.

The first known study (Schwartz et al, 1986) on the biomechanics of head injury in martial arts used an accelerometer instrumented Hybrid II Crash Test Dummy head and neck complex mounted to an immovable concrete post. Although details of the results were limited, this study provided a framework for the most recent investigations on the topic (Fife et al., 2012; Fife et al., 2011; O'Sullivan et al., 2013; Fife et al., 2013). In taekwondo, head impact mechanics were first observed among a small cohort (4 elite subjects) where mean head accelerations imparted by the turning kick reached 72 G for males and 68 G for females (Fife et al., 2013). A follow-up study confirmed the turning kick to reach the highest impacts (130 G) among elite male competitors. From these results and an earlier unpublished study (Moffit and Lieu, 1995) a novel experiment (O'Sullivan et al., 2013) of headgear impact attenuation was conducted leading to the present study. While the first published taekwondo helmet safety investigation provided great insight into the shortcomings of World Taekwondo Federation (WTF) – approved protective headgear, the current study provides a more sophisticated methodology.

The purpose of this study, then, was to investigate the impact attenuation properties of protective taekwondo footpads by evaluating their ability to reduce peak resultant linear acceleration (RLA) of an instrumented head-form.

Methods

A standardized (ASTM F-2397) martial arts headgear striker was used to impart impacts to a 50th Percentile Male Hybrid III Crash Test Dummy (Hybrid III) head and neck complex. The striker (mass = 4.5 kg) consisted of an aluminum tube (length = 500 mm, diameter = 80 mm) mounted to a ball-bearing pivot point rotating about a solid aluminum pipe. The peak velocity of the striker was controlled by a three-wheeled weighted (mass = 100 kg) pulley system. The striker complex was securely mounted to a three-dimensional T-shaped steel beam structure (approx. 200 kg). Offset from the center of the supportive structure, hanging upside down on four separate lines of linked chains, was a steel pendulum-like structure of the same inertial properties (25 kg) as the upper body of a Hybrid III Dummy. The Hybrid III head and neck Dummy were mounted to the body structure and situated to impart side impacts. Mounted at the HCOG was one 500 G tri-axial sensor (PCB-355A66) used to obtain resultant linear accelerations of the head (RLA). A customized data processing program (LABVIEW Signal Express 2013, National Instruments, USA) was used to record and export the accelerometer and photoelectric sensor (BX700-DDT, Autronics,

USA) data. All impacts were imparted with a terminal striking velocity of 5.0 m/s (max-min=5.15-4.75 m/s). Terminal striking velocity was verified by using the time the striker took to pass the photoelectric sensor field. Acceleration data were sampled according to CFC 1000 (SAE, 1995) via a USB connected Compact DAQ chassis (cDAQ-9174, National Instruments). Three different conditions were employed (no footpad, current WTF-approved footpad of 8 mm, and a thick footpad of 12 mm). Each footpad condition was tested for a total of ten impacts (30 total impacts). A large headgear (VISION, USA) was fitted to the Hybrid III. To control for the effects of repeated impacts on one helmet side, 15 impacts were imparted to the right side and 15 impacts to the left side. Impacts were randomly administered using the automatic random allocation tool from Microsoft Excel 2007 (Microsoft, USA). To assess the differences between the footpad conditions, a 1-way ANOVA was performed using SPSS version 20.0. The level of significance was set to an effect size of 0.2 (Hopkins, Sportsci.org).



Fig. 1 ASTM F-2397 standard martial arts protective headgear striker

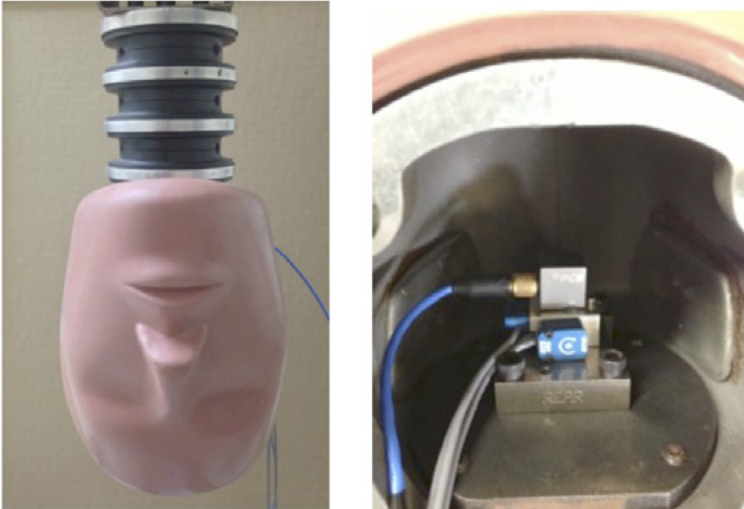


Fig. 2 Hybrid III Crash Test Dummy Head and Neck Complex (left) and accelerometer set-up (right)



Fig. 3 No footpad condition (left), World Taekwondo Federation-approved footpad (center) and thick footpad (right). It should be noted that the thick pad was commonly employed during taekwondo competitions. However, at the time of its use, no official regulation existed for foot protection

Results

There was a significant difference between the types of padding relative to RLA of the instrumented head ($\eta^2=0.93$). The results of the pairwise comparisons are shown in Table 1.

Tab. 1 Descriptive statistics of and comparisons between footpad conditions

RLA (g) Comparisons	d (95% CI)
WTF footpad vs. Thick footpad 35.75 ± 2.92 vs. 26.27 ± 1.48	4.31 (2.50 – 5.23)
WTF footpad vs. No footpad 35.75 ± 2.92 vs. 50.34 ± 3.72	4.39 (2.09 – 6.20)
Thick footpad vs. No footpad 26.27 ± 1.48 vs. 50.34 ± 3.72	9.26 (6.95 – 10.17)

Discussion

The results of this study bring to light two interesting points. First, our most recent work (O’Sullivan et al., 2013) identified through a novel testing apparatus that five different protective headgear did not meet minimum requirements to be able to mitigate impacts of 50 G and 150 G.

This previous study employed the use of a 5.0 kg bowling ball to impart impacts that did not take into account the protective footpads used during competition. As footpads serve to protect the foot, an obvious benefit is the additional padding that is expected to further increase the attenuation properties of the headgear. Although the WTF approved footpad was 4 mm thinner than the footpad most often used prior to regulated footpad use, it still helped dissipate forces to the Hybrid III head and neck complex. Currently we do not see a logical reason behind using a thinner footpad, especially if the thicker pad provides greater protection for head impacts. It must be noted that only one headgear model and two footpad models were tested. Future testing must include a comprehensive assessment of all protective headgear and footpads. Additionally, future testing must not go without testing impacts at higher velocities as specified by the martial arts headgear standard (ASTM).

Conclusions

The results of this study indicate that using the thick footpads (not approved by the WTF) provided the greatest attenuation of impact from the striker when a WTF-

approved protective headgear was impacted. The WTF-approved pad, however, did provide attenuation properties which yielded satisfactory RLA values (i.e., below passing limits of ASTM F-2397). Possibly a safer alternative to the current WTF-approved pad may be one similar to the thick pad tested in this study. It is recommended that future studies test more than one protective headgear model, different sizes and other footpad models.

References

ASTM Standard Designation: F 2397-04 Specification for Protective Headgear Used in Martial Arts.

Engebretsen L, Soligard T, Steffen K, Alonso JM, Aubry M, Budgett R, Dvorak J, Jegathesan M, Meeuwisse WH, Mountjoy M, Palmer-Green D, Vanhegan I, Renström PA. Sports injuries and illnesses during the London Summer Olympic Games 2012. *Br J Sports Med.* 2013 May;47(7):407-14. doi: 10.1136/bjsports-2013-092380. Epub 2013 Mar 20.

Fife GP, O'Sullivan DM, Pieter W, Cook DP, Kaminski TW. Effects of Olympic Style Taekwondo Kicks on an Instrumented Head-Form and Resultant Injury Measures. *Br J Sport Med.* 2011;45:318-319.

Fife GP, O'Sullivan DM, Pieter, W, Kaminski T. The effects of taekwondo kicks on head accelerations and head injury: a pilot study. *Int SportMed J.* 2013;14(2): 53-66.

Hopkins GW. A New View of Statistics. Available at: <http://www.sportsci.org/resource/stats/effectmag.html> (accessed 5 April 2012).

Junge A, Engebretsen L, Mountjoy ML, Alonso JM, Renström PA, Aubry MJ, Dvorak J. Sports injuries during the Summer Olympic Games 2008. *Am J Sports Med.* 2009 Nov; 37(11):2165-72. doi: 10.1177/0363546509339357. Epub 2009 Sep 25.

Moffitt M, Lieu D. Response of martial arts headgear to simulated kicks (thesis). Berkley, University of California, 1995.

O'Sullivan DM, Fife GP, Pieter W, Shin I. Safety performance evaluation of taekwondo headgear. *Br J Sports Med.* 2013 May; 47(7):447-51. doi: 10.1136/bjsports-2012-091416. Epub 2013 Jan 24.

Pieter W, Fife GP, O'Sullivan DM. Competition injuries in taekwondo: a literature review and suggestions for prevention and surveillance. *Br J Sports Med* 2012; 46:485-491 doi:10.1136/bjsports-2012-091011.

SAE. Instrumentation for impact test – part 1: electronic instrumentation. SAE paper no. J211/1. Warrendale, PA: Society of Automotive Engineers, 1995.

Schwartz ML, Hudson AR, Fernie GR, Hayashi K, Coleclough AA. Biomechanical study of full-contact karate contrasted with boxing. *J Neurosurgery.* 1986; 64: 248-252.

Are asthmatic children prone to obesity?

Renata Vařeková¹, Ivan Vařeka^{1,2}

¹Faculty of Physical Culture, Palacký University, Olomouc, Czech Republic

²University Hospital, Hradec Králové, Czech Republic

Abstract

The group consisted of 76 children (36 boys and 40 girls at the age of $x = 12.3$ years, $SD \pm 3.23$), who have been treated for asthma bronchiale. Body weight, height and BMI were assessed according to the percentile charts by age (Vignerová, 2001). Fat percentage was determined by Bioimpedance and evaluated according to the InBody 720th chart. The results demonstrate high prevalence of overweight / obesity and a high percentage of body fat in asthmatic children and thus necessity of dietary adjustments and increase in physical activity.

Keywords: *asthma bronchiale, children, body height, body weight, BMI, percentage of fat.*

Introduction

Overall, topic on obesity and asthma has been well studied; need a more comprehensive review and describe what is new for the current study (e.g., a local sample); see a recent review by Papoutsakis C: <http://www.ncbi.nlm.nih.gov/pubmed/23260726>

Asthma bronchiale is currently one of the most common chronic lung diseases. Its prevalence has been steadily increasing, especially among the youngest age groups. Every ten years, the prevalence doubles. The estimated figure of asthma prevalence in the Czech Republic is 8 % of population, and almost double that number in children. WHO (WHO 2011) estimates that 235 million people currently suffer from asthma.

The coincidence of bronchial asthma and obesity or higher body fat percentage has been repeatedly described and the literature dealing with it is abundant. The first reports of association of asthma and obesity emerged in the 1980s [Seidel et al., 1986; Negri, Pagano, Decarli & La Vecchia, 1988] and the number of these studies rose exponentially until the late 1990s. The detailed summary of the problem has been completed in many meta-analyses [Shore & Johnston, 2006; Beuther & Sutherland, 2007].

Gruchala-Niedoszytko, Małgorzewicz, Niedoszytko, Gnacińska and Jassem (2013) summarized results of various studies on animal models as well as studies on asthmatic patients with the following conclusions: 1) the associations between obesity and asthma can be not only causal but also accidental, 2) the levels of inflammation markers in

obese asthmatics are related to the parameters of obesity, 3) asthma in obese subjects can differ from the obvious phenotype of this disease and their response to standard medication is reduced

In recent years, there have been many studies indicating that contemporary lifestyle characterized by hypo-activity and excessive food intake has a negative effect on body composition from the youngest age. In asthmatic children, this trend is aggravated by chronic inflammatory processes, long-term administration of corticoids and often by restriction of physical activities out of fear of onset of acute asthma. The aim of this study was to monitor body composition and anthropometric parameters in asthmatic children and comparing them to the standard norms of general population.

Methods

The sample group consisted of 76 asthmatic children (36 boys and 40 girls, $M = 12.3$ yr. old, $SD \pm 3.23$). Body composition was monitored by bioimpedance method (In Body 720), anthropometric parameters (body weight and height) and BMI were assessed according to percentile charts by age categories (Vignerová, 2001).

Results and discussion

Concerning body weight, 19.5 % of boys were below the standard of the Czech Republic, 33 % of boys were within the standard. The group above the standard was the most numerous 47.5 % - this group can be divided into 14 % increased weight (robust) boys, 5.5 % overweight boys and 28 % clearly obese.

Fifteen percent of asthmatic girls were below the standard of the Czech Republic, 40 % were within the standard. Similarly as in the boys, the most numerous group 45 % were the girls above the standard - of whom 15 % had increased weight (robust), 15 % was overweight and 15 % was clearly obese ($90 <$ percentile).

The average BMI is 21.9 for boys ($SD \pm 6.74$) and 20.32 ($SD \pm 4.36$) in girls, which is the zone of excessive weight.

Evaluation of individual body fractions by InBody 720 device confirmed previous findings. The values of muscular component indicate a hypo-active lifestyle, with only 50 % of the boys and 55 % of the girls being within the standard. 35 % of the boys and 37 % of the girls were below the standard. Similar trend was found in body fat measurement. Only 39 % of boys and 33 % of girls were within the standard and 47 % of boys and 50 % of girls had above the average values.

Concerning body height of asthmatic children, 48 % of boys and girls were below the standard and were classified as small, only 37 % of boys and 35 % of girls were within

the standard (medium) and only 16 % of boys and 18 % of girls were rated as above the average (tall).

Evaluation of body height as “small” is particularly noticeable in older age groups, both in boys and girls. There are even children in the range of 3-10 in percentile chart in body height and 97 in percentile chart in body weight.

Allen (Allen, 2006) has monitored and compared the height of children suffering from chronic disease and he stated that chronic inflammation and long-term administration of corticoids affect the thyroid gland which can slow down or limit the growth in asthmatic children.

Conclusions

These figures show prevalence of overweight and obesity in asthmatic children and an inappropriate ratio of individual body components from the youngest age - excessive amount of body fat and reduced muscle component. Unsatisfactory state of locomotor system and the body posture have been repeatedly stated (Vařeková, 2005).

For these reasons, it is recommended to increase physical activity and incorporate suitable dietary changes. Fear of post-activity bronchospasm may limit physical activity (Neumannová, 2011). This type of asthma is known as exercise-induced asthma (EIA). Therefore, it is necessary to modify the pharmacological treatment in terms of prevention (systematic disease control, anti-inflammatory therapy and preventive medication administered prior to the increased physical activity).

References

- Allen, D. B. (2006). Growth and Development of the Child with Asthma. In S. I. Szeffler (Ed.), *Childhood Asthma* (pp. 125-151). New York: Taylor & Francis.
- Beuther, D. A., & Sutherland, E. R. (2007). Overweight, obesity and incident asthma: a meta-analysis of prospective epidemiologic studies. *American Journal of Respiratory Critical Care Medicine*, 175(7), 661-666.
- Gruchała-Niedoszytko, M., Małgorzewicz, S., Niedoszytko, M., Gnacińska, M., & Jassem, E. (2013). The influence of obesity on inflammation and clinical symptoms in asthma. *Advances in Medical Sciences*, 58(1), 15-21.
- Negri, E., Pagano, R., Decarli, A., & La Vecchia, C. (1988). Body weight and the prevalence of chronic diseases. *Journal of Epidemiology and Community Health*, 42(1), 24-29.
- Neumannová, K. (2011). Rozvíjení hrudníku, ventilační parametry a vybrané kineziologické ukazatele u nemocných s asthma bronchiale a chronickou obstrukční plicní nemocí. *Rehabilitace a fyzikální lékařství*, 18(3), 132-137.
- Seidell, J. C., de Groot, L. C., van Sonsbeek, J. L., Deurenberg, P., & Hautvast, J. G. (1986). Associations of moderate and severe overweight with self-reported illness and medical care in Dutch adults. *American Journal of Public Health*, 76(3), 264-269.
- Shore, S. A., & Johnston, R. A. (2006). Obesity and asthma. *Pharmacology and Therapeutics*, 110(1), 83-102.
- Vařeková, R., Vařeka, I., Burianová, K., Zdražilová, E., Riegerová, J. & Hak, J. (2005). Srovnání výskytu svalových dysbalancí a držení těla mezi dětmi s astma bronchiale a běžnou populací. *Česká antropologie*, 55, 126-128.
- Vígnerová, J., & Bláha, P. (2001). Sledování růstu českých dětí a dospívajících. SZÚ, Praha.
- WHO (2011). Bronchial asthma [on line] Retrieved 27. 2. 2013 on the World Wide Web: <http://www.who.int/respiratory/asthma/en>

Influencing postural stability parameters by means of a power yoga exercise programme for students

Vít Černý¹, Kateřina Feitová²

¹Faculty of Physical Education and Sport, Charles University in Prague Czech Republic

^{1,2}Faculty of Science, Charles University in Prague, Czech Republic

Abstract

Partial results of a study measuring changes in the level of postural stability due to exposure to a power yoga programme are presented.

A three-month intervention programme was implemented within the learning plan of a university physical education course. The study sample consisted of 80 second-year students from the Faculty of Science who were assigned to the experimental and control groups. Measurement of the postural stability level was done using selected tests in the Laboratory of Motor Sports of the Faculty of Physical Education and Sport of Charles University in Prague. The footscan stabilometry platform was used to carry out the tests.

The favourable effect of the intervention programme (IP) was confirmed in comparison to the control group. In the experimental group, a decrease in the average lateral deflection of the centre of gravity while in a wide stance with open eyes was found when compared to the baseline. A lower average lateral deflection value while in a narrow stance with closed eyes was also found in the intervention group.

The results will guide adjustments to the power yoga intervention programme within the complex research of the motion programme efficiency and as arguments to support the benefits of this physical activity for university students. They should also help to improve the offer of elective courses in physical education, to cultivate the locomotion base, to eliminate muscle imbalances, to influence components of physical fitness and to support the motivation and interest of students of the Faculty of Science in physical education.

Keywords: *Exercise program, power yoga, postural stability.*

Acknowledgement

This article was created within PRVOUK P38 and P39 research task and supported from specific university research SVV 2013 – 267603 and research project VZ MSM 0021620864.

Introduction

Our study deals with the problems concerning application of new forms of gymnastic programmes within physical education courses at universities. There is a great interest in various gymnastic programmes, especially amongst female students, the content of which corresponds to the actual needs of physical self-realisation related to the university studies life period.

Physical education at universities has its own specific challenges. Although the forms of exercise offered in the commercial sphere are used in the lessons, emphasis is also placed on the training and education of students. Not only can the favourable effects on physical fitness and mental resistance be achieved via exercise programmes, but the needs of social contact, intentional mental relaxation and compensation of mental stress during studying can also be met (Nykodým; Mitáš 2010). The power yoga programme is one such programme. It is often linked to the improvement of the coordination skills of the exercisers (Howe 2011; Thomley 2011).

Balance is one of the basic coordination skills. It is the ability to keep the body balanced during physical activity or to restore it if impaired (Doležalová; Lednický 2002). It should be realised that maintaining a steady posture is not a static state but a process that is “confronted” by the natural instability of the musculoskeletal system. The ability to maintain body posture to prevent uncontrolled falls is called postural stability. Increasingly more attention is paid to the issue of postural stability in sport. Stabilometry is not only used in clinical practice or rehabilitation, but it finds further application in assessment of the effect of various physical exercise forms. The skill to maintain a stable posture is an important factor affecting the ability to perform more asanas and vinyas of the exercise programme. As a complex body function which is provided by neuromuscular, vestibular and visual systems, it can be influenced by numerous factors (age, sex, health and mental state, injuries). Each individual has a different degree of congenital disposition for this skill that can be developed and improved through focused training.

Existing results of experiments carried out with yoga exercises are consistent in terms of the positive effect of inclusion of the balance positions on postural stability (Omkar; Vishwas; Tech 2007). Available literature only marginally deals with this issue in relation to power yoga and the experiments are mainly targeted towards classical yoga (hatha yoga). The exercises are similar in terms of the use of yoga asanas and differ in the exercise speed, thus in the duration of individual muscle group loads. The exercise system enables determination of the deeper structures of one’s own personality and to understand the rules which control it. That is why we consider the given exercise programme, which leads to the normalisation of nervous system activity and harmonisation of the psyche of the individual, to be a complexly

developing physical activity especially suitable for university students. Therefore, power yoga has a great effect on the harmonisation of students' personalities and on the quality of their interrelationships (Krejčí 1995).

The power yoga programme contains a number of balance positions (asanas) and their proper implementation can be influenced simply by the level of postural stability. Only technically correct exercises can influence the components of physical fitness, good posture and other declared power yoga effects.

The aim of this article is to verify the effect of the power yoga intervention programme (implemented by a teacher within the university physical education course) on postural stability parameters in Faculty of Science students at Charles University in Prague.

Methods

Study organisation

The experiment took place within the university environment of the Faculty of Science of Charles University in Prague. The intervention power yoga programme was conducted in the form of group exercise and applied within the study plan of the physical education lessons at the university. The purpose of the investigation was to determine whether the effects of the three-month power yoga programme is noticeable when compared to the control group.

The intervention programme, which was applied once a week for ninety minutes, included basic motion sequences (vinyasas) of the exercise programme. It was based on a study by one of the power yoga founders B. Baptista (1988). Because yoga asanas are balance positions and the conscious maintaining of these positions is a balance exercise combined with static muscle strengthening, we have also assumed their positive effect on the balance and parameters of postural stability. Measurements in both the experimental and control groups were made at the beginning and end of the evaluation period (pre-test and post-test). Measurements were carried out on day 1 under the standard conditions according to Kapteyn (1983). The basic anthropometric characteristics of the respondents (body height and body weight) were measured together with other characteristics (age, foot size, laterality). All of these data were recorded in a simple survey which was assigned to the respondents prior to the measurements. An experimental method of empirical research was used (Blahuš 1996). It comprised evaluation of intergroup relations between the input variable in the form of the power yoga programme application and the output variable represented by the results of the selected tests.

Ethics committee of FTVS UK in Prague approved the study. Probands were informed and agreed (by written evidence) with the study.

Study sample

The research sample consisted of 80 second-year female students from the Faculty of Science. From 160 students enrolled in the power yoga course, the experimental group (40 students) with the three-month IP and the control group (40 students) who were reassigned to another type of physical education and did not participate in the IP, were chosen by lottery. The effect of the intervention programme on the postural stability parameter changes was evaluated during its implementation.

Study design

Randomised Groups Design was chosen as the study design. Base population was created by students registered into the power yoga course. Randomisation was achieved by drawing of lots. Students determined to not attend the power yoga course were asked to select different physical education course. It searches for significant differences before and after manipulation with the independent variable. There was 1 independent variable in our case. ANOVA was used to evaluate the dependence. The goodness of fit test χ^2 was used to confirm the normality of the tested variables. Coefficient ω^2 was used to evaluate the substantive significance.

Methods of measurement

Standardised stability tests according to Kapteyn (1983) were used for the measurements.

T1: wide stance with open eyes (SS OO)

T2: wide stance with closed eyes (SS ZO)

T3: narrow stance with open eyes (US OO)

T4: narrow stance with closed eyes (US ZO)

T5: flamenco stance on the left foot (FLL)

T6: flamenco stance on the right foot (FLP)

Every proband spent 30 seconds in each prescribed position. Measurements were performed on the Footscan stabilometric platform with the sampling frequency 500 Hz. The result values are expressed in millimetres.

The following variables were measured:

x_1 average lateral deflection: 1st measurement (measured before intervention)

x_2 average lateral deflection: 2nd measurement (measured after intervention)

y_1 average frontal deflection: 1st measurement (measured before intervention)

y_2 average frontal deflection: 2nd measurement (measured after intervention)

ttw_1 trajectory of the projection of the centre of gravity in the horizontal plane: 1st measurement (measured before intervention)

ttw_2 trajectory of the projection of the centre of gravity to the horizontal plane: 2nd measurement (measured after intervention).

Subsequently, we used derived variables for the analysis

$$x_ratio = x_1 / x_2$$

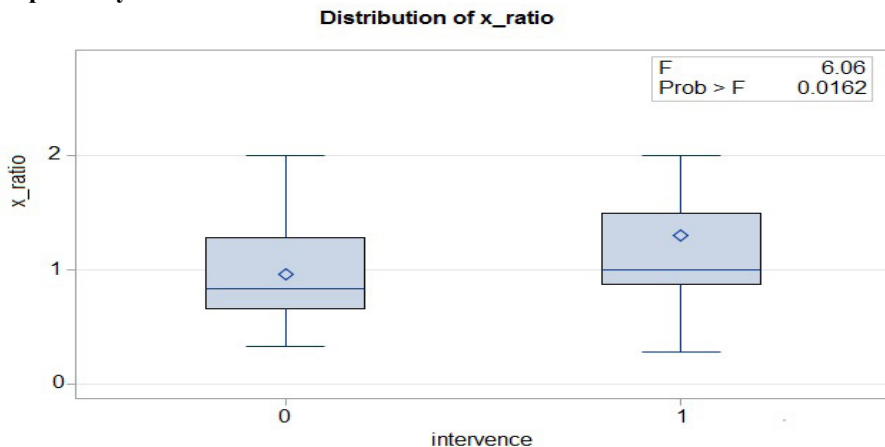
$$y_ratio = x_1 / x_2$$

$$ttw_ratio = ttw_1 / ttw_2$$

Results and Discussion

Measurements of the postural stability parameters were carried out in randomly selected female students at the beginning and end of the 12-week period during which the power yoga exercise programme was applied. The following results confirming the positive effect of power yoga on the postural stability of the probands were obtained. As shown in the figures, the group completing the intervention has a lower relative lateral deflection ($p = 0.0162$, $\omega^2 = 0.3$). It could be concluded that the intervention programme had a favourable effect on the perceptual-motor system regulating stability in a lateral direction. Why exactly this direction was influenced should be the subject of further research. The study samples were relatively small (tens of observations). This suggests the sufficient substantive significance of ω^2 .

Fig. 1: Relative lateral deflection for groups without and with intervention respectively.



intervence = intervention

Conclusion

The aim of this scientific research was to prove the positive effects of power yoga on the human body and lifestyle. The partial results of the measurement already show the improvement of postural stability. We have proven the positive contribution of power yoga on postural stability in the lateral direction.

Wide stance with open eyes x_ratio : $p = 0.0162$, $\omega^2 = 0.3$

Measurements of other body parameters and motion skills could support the importance of power yoga for a healthy and active lifestyle. The question remains as to why only the lateral and not the frontal direction was influenced. We will try to answer this question in further research.

References

Baptiste, B. Poweryoga. New York: Omega, 1988.

Blahuš, P. K systémovému pojetí statistických metod v metodologii empirického výzkumu chování. Prague: Karolinum, 1996.

Doležalová, L.; Lednický, A. Rozvoj koordinačních schopností. Bratislava: SVTVŠ, 2002.

Howe, T. E.; Rochester, L.; Neil, F.; Skelton, D. A.; Ballinger, C. Exercise for improving balance in older people. Cochrane database of systematic reviews, 2011.

Kapteyn, T. S.; Bles, W.; Njiokiktejn, CH. J.; Kodde, L.; Massen C. H.; Mol, J. M. F. Standardisation in Platform Stabilometry being a Part of Posturography. *Agressologie*, 24 (7), 321-326, 1983.

Kolář, P. Rehabilitace v klinické praxi. Prague: Galén. ISBN 978-80-7262-657-1. 2009.

Krejčí, M. Jóga v praxi pedagoga. České Budějovice: PF JU, 1995.

Krejčík, V. Zdravý život s powerjóga. Prague: Ikar, 2005.

Nykodým, J.; Mítáš, J. Pohybová aktivita vysokoškoláků. In MUŽÍK; VLČEK (EDS.) Škola, pohyb a zdraví: výzkumné výsledky a projekty. Brno: Masaryk University, 2010, pp. 153-168. ISBN 978-80-210-371.

Omkar, S. N.; Vishwas, S.; Tech, B. Yoga techniques as a means of core stability training. *Journal of Bodywork and Movement Therapies* 13, pp. 98-110, 2007.

Strešková, E. Rozvoj koordinačních schopností ako predpoklad skvalitnenia technickej prípravy v športe. Zborník prednášok zo vzdelávacích aktivít národného športového centra. Bratislava, 2004, p. 234.

Thomley, B. S.; Ray, S. H.; Cha, S. S.; Bauer, B. A. Effects of a brief, comprehensive, yoga-based program on quality of life and biometric measures in an employee population: a pilot study. *New York: Explore* 7 (1), 27-29, 2011.

Véle, F. Kineziologie. Prague: Triton, 2006.

The cost of running on different surfaces in long distance runners

Martina Bernaciková, Jaroslava Chovancová, Tomáš Kalina

Faculty of Sport Studies, Masaryk University, Brno, Czech Republic

Abstract

This study tests if running economy differs on three surfaces (tartan, cinder and asphalt) in long distance runners. We measured oxygen uptake (parameter of running economy) breath-by-breath in 30 long distance runners (age: 25 ± 4 years, height: 183 ± 7 cm and body mass: 72 ± 6 kg and VO_{2max} : 65.9 ± 5.2 ml·min⁻¹·kg⁻¹) by wireless, portable cardiopulmonary stress testing system (Oxycon Mobile). All test subjects were running in the same road racing running shoes. Athletes ran 4 stages lasting 4 minutes at velocities 10, 12, 14 and 16 km·h⁻¹ with a 4-minute break on each surface. ANOVA proved statistical dependence at variable surface ($p=0.00$) and speed ($p=0.00$). Interaction isn't proved (surface x speed, $p=0.95$). Differences in metabolic-energy running economy indicators were assessed statistically using a Tukey's HSD test. We found significant differences ($p<0.05$) between asphalt-cinder and tartan-cinder. The lowest values were measured on asphalt surface. Differences of average values of oxygen uptake (for 10, 12, 14, resp. 16 km·h⁻¹) on tartan (35.3, 41.1, 47.7 and 54.5 ml·min⁻¹·kg⁻¹), cinder (36.1, 42.6, 49.3 and 56.2 ml·min⁻¹·kg⁻¹) and asphalt (35.1, 39.9, 46.7 and 53.5 ml·min⁻¹·kg⁻¹) were on the edge of device error (50 ml·min⁻¹). The lowest values of oxygen uptake were found out on asphalt surface. The asphalt is probably the most convenient surface according energetic aspect for these specific shoes.

Keywords: cost of running, running economy, oxycon mobile, long distance runners, surface, oxygen uptake.

Introduction

Endurance is conditioned by three mutually independent factors: the maximum oxygen uptake (VO_{2max}), cost of running, and the % of VO_{2max} at the anaerobic threshold (ANT) (Coyle 1999, Stephard and Astrand 2000, Kravitz and Dalleck 2002, Midgley et al. 2007, Grasgruber and Cacek 2008). Cost of running is typically defined as the energy required running sub maximally at a given velocity and is determined by measuring steady-state oxygen consumption (VO_2). Runners with good running economy spend less energy and, therefore, less oxygen than runners with poor running economy (Saunders et al., 2004). Cost of running is influenced by several exogenous factors, one of which is surface. Sassi et al. (2011) found out a worse the cost of running on natural grass and artificial turf surfaces than on hard surface (asphalted

track). Cost of running on different surfaces was presented in articles by Pinnington and Dawson (2001), Zamparo et al. (1992, 2001), Lejuene et al. (1998), di Prampero et al. (1993), Rodio et al. (2004).

Pinnington and Dawson (2001) presented results of measuring on soft dry beach sand and grass (8, 11 and 14 km·h⁻¹). They investigated significantly greater values during running on soft dry beach than when running on grass at 8 km·h⁻¹. Zamparo et al. (1992) reported that at running speeds ranging between 7 and 14 km·h⁻¹, the energy cost of sand running was 5.3 J·kg⁻¹·m⁻¹, or approximately 24% greater than firm-ground values. Lejuene et al. (1998) reported that the net aerobic economy cost of running on an artificial circular sand track was approximately 6.7 J·kg⁻¹·m⁻¹, or 1.6 times greater than running on a hard surface. Di Prampero et al. (1993) who measured cost of running on tartan presented values 3.7 J·kg⁻¹·m⁻¹. Rodio et al. (2004) measured higher values (10%), which were found in a study that compared natural vs. artificial turf surfaces. These authors were limited by small subjects' numbers (about 10).

They looked into running economy on hard surface, sand and grass. But we didn't find articles about differences between tartan, cinder and asphalt. We suggest that there are significant differences in running economy and oxygen uptake on different surfaces (tartan, cinder and asphalt) and certain velocity. Perl et al. (2012) and Lussiana (2013) published differences between various types of footwear. We decided to choose the same type of racing shoes owing to elimination one of the exogenous factors.

Methods

This study contains 30 well-trained persons with long-distance running specialization (Tab 1).

Tab. 1 Subject characteristic

N = 30	Mean	Minimum	Maximum	SD
age (y)	25.1	17.2	35.4	4.3
height (cm)	183.2	163.0	196.0	7.4
body mass (kg)	72.5	60.0	83.0	6.0
BMI	21.6	18.9	24.0	1.4
VO2max (ml·min ⁻¹ ·kg ⁻¹)	65.9	57.2	75.4	5.2

Each runner completed 3 tests (during 14 days) on different surfaces – tartan, cinder and asphalt. These tests were performed on running tracks. We used modified Saltin's sub maximal test (1995) for evaluation of RE. Each test contained 4 four-minute stages (10, 12, 14 and 16 km·h⁻¹) with 4 minutes break between stages. Velocity of stage was set up and controlled by several ways: knowledge of certain split time, markers (cones) every 100m and sound signal from speaker. Runners were communicated specific lap time, which had to be caught up on the cone. Control sound was produced by the software Conconi test (Kalina, 2012).

Monitoring of physiological parameters of RE were performed by device Oxycon Mobile (Viasys, Germany) – gas analyzer.

All runners used the same type of shoes. We selected road racing shoes Gel-Hyperspeed 5 (Asics, Japan) with weight 211 g (size UK 8) with reduced amount of cushion of midsole. Different type, age and wear of shoes can be one of hidden effect of cost of running. Runners used selected shoes only for 3 tests including warm-up and cool-down.

Analysis of absolute oxygen uptake (VO₂) and relative oxygen uptake per kilogram of mass (VO₂·ml⁻¹·kg⁻¹) was performed on Oxycon Mobile's exported data which was averaged in 15 seconds interval in last 2 minutes of each stage (velocity). We used average value as an average of values between 2nd and 3rd quartiles. Values of area under Q1 and above Q3 were not included in our analysis due to dampen extreme values (Q0.75–Q0.25 is included).

We used analysis of variance (ANOVA) for statistical evaluation, factors (independent variables) were surface and velocity, dependent variables was VO₂ (ml·min⁻¹·kg⁻¹). We also used Tukey HSD test to identify different groups. We used sw Statistica 10 by Statsoft.

Results

Differences of average values of oxygen uptake were (for 10, 12, 14, resp. 16 km·h⁻¹) on tartan (35.3, 41.1, 47.7 and 54.5 ml·min⁻¹·kg⁻¹), cinder (36.1, 42.6, 49.3 and 56.2 ml·min⁻¹·kg⁻¹) and asphalt (35.1, 39.9, 46.7 and 53.5 ml·min⁻¹·kg⁻¹) – see table 2.

Tab. 2 Means of oxygen uptake on different surfaces and velocities

velocity km·h ⁻¹	surface	VO ₂ /kg ml·min ⁻¹ ·kg ⁻¹
10	tartan	35.3
10	cinder	36.1
10	asphalt	35.1
12	tartan	41.1
12	cinder	42.6
12	asphalt	39.9
14	tartan	47.7
14	cinder	49.3
14	asphalt	46.7
16	tartan	54.5
16	cinder	56.2
16	asphalt	53.5

ANOVA (see table 3) proved statistically depending at variable surface (p=0.00) and speed (p=0.00). Interaction isn't proved (surface x speed, p=0.95).

Tab. 3 ANOVA for VO₂/kg (surface x speed, p=0.95)

Effect	ANOVA (p < 0.05 are shown in red colour)				
	SS	DoF	MS	F	p
Intercept	721821.6	1	721821.6	36565.92	0.000000
surface	321.0	2	160.5	8.13	0.000354
velocity	18640.6	3	6213.5	314.76	0.000000
surface*velocity	31.6	6	5.3	0.27	0.952184
error	6849.9	347	19.7		

Results found no significant differences in oxygen uptake (VO₂) on tartan-asphalt. But we found out significant differences between cinder-asphalt and cinder-tartan see table 4.

Tab. 4 Tukey HSD test for VO₂/kg. Significant different pairs (p < 0.05) are shown in red colour

velocity		10 km·h ⁻¹			12 km·h ⁻¹			14 km·h ⁻¹			16 km·h ⁻¹		
km·h ⁻¹	surface	tartan	cinder	as-phalt	tartan	cinder	as-phalt	tartan	cinder	as-phalt	tartan	cinder	as-phalt
10	tartan		0.481	0.836	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	cinder	0.481		0.362	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000
10	asphalt	0.836	0.362		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12	tartan	0.000	0.000	0.000		0.189	0.286	0.000	0.000	0.000	0.000	0.000	0.000
12	cinder	0.000	0.000	0.000	0.189		0.018	0.000	0.000	0.000	0.000	0.000	0.000
12	asphalt	0.000	0.001	0.000	0.286	0.018		0.000	0.000	0.000	0.000	0.000	0.000
14	tartan	0.000	0.000	0.000	0.000	0.000	0.000		0.159	0.380	0.000	0.000	0.000
14	cinder	0.000	0.000	0.000	0.000	0.000	0.000	0.159		0.022	0.000	0.000	0.000
14	asphalt	0.000	0.000	0.000	0.000	0.000	0.000	0.380	0.022		0.000	0.000	0.000
16	tartan	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.140	0.366
16	cinder	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.140		0.017
16	asphalt	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.366	0.017	

Discussion

Energy cost values for asphalt running at speeds 10 and 12 km·h⁻¹ have previously been reported to range 35.6 and 43.4 ml·min⁻¹·kg⁻¹ (Sassi et al., 2011) in soccer players. We measured 35.1 and 39.9 ml·min⁻¹·kg⁻¹ in endurance runners for same velocities. Our values are lower than results published by Sassi (2011), especially at speed 12 km·h⁻¹. We found out better cost of running for asphalt surface for this velocity. Sassi (2011) compared cost of running between asphalt and grass. He reported 37.7 and 46.2 ml·min⁻¹·kg⁻¹ of running on grass in soccer players.

Pinnington et. al. (2001) have reported mean energy cost values of 42.7 and 58.2 ml·min⁻¹·kg⁻¹ at speed 11 km·h⁻¹ of running on grass and sand in elite surf iron men.

In our previous study (Novotna et al., 2008) we measured running economy in runners on tartan. We found out similar results at speeds 12, 14 and 16 km·h⁻¹ of VO₂/kg 35.8, 40.8, 46.0 ml·min⁻¹·kg⁻¹ in marathon runners. We tested middle-distance runners with VO₂/kg 38.1, 44.1, 49.4 ml·min⁻¹·kg⁻¹.

We evaluated present results as significant between cinder-asphalt and cinder-tartan. We hypothesise that when running on cinder, foot contact time is longer than when running on asphalt or tartan surface, due partly to a need to gain stability and to foot slippage.

Conclusion

We drew a comparison between tartan, cinder and asphalt surface. We tried to quantify oxygen uptake, which is in inversion relationship to energy intensity (at certain velocity less oxygen uptake means less cost of energy; indirectly shows better endurance). We concluded that for sport performance optimization to be preferred asphalt and tartan surface than cinder with use of certain type of shoes. On the other hand, this surface is not so good for health of leg joints. Differences between tartan-asphalt are not significant, but we can see similar to results for cinder- tartan and tartan-cinder. We suggest measuring of running economy on more other surfaces (e.g. grass, sand) in different groups (e.g. runners, soccer players, non athletes) and compare these results with measuring on tartan and asphalt. This project was financed by Masaryk university specific student research MUNI/A/0802/2012.

References

Bassett, D. R., Howey, E. T. (2000). Limiting factors for maximum oxygen uptake and determinants of endurance performance. *Medicine and Science in Sports and Exercise*, 32, 70-84.

Coyle, E.F. (1999). Physiological determinants of endurance exercise performance. *J Sci Med Sport*, 3, 181-189.

Grasgruber, P., Cacek, J. (2008). *Sportovní geny* (1st ed.). Brno, Czech republic: Computer Press.

Kalina, T. (2012). Možnosti realizace modifikovaného Conconiho testu pro běžce. In Suchý, J. et al. (Eds.) *Scientia Movens 2012: Sborník příspěvků z mezinárodní studentské vědecké konference*. (pp 16-22). Praha, Czech Republic: Univerzita Karlova v Praze, Fakulta tělesné výchovy a sportu.

Kravitz, L., Dalleck, L.C. (2001). Physiological factors limiting endurance exercise capacity. *IDEA Health and Fitness Source*, 20, 4, 40-49.

Lejuene, TM., Willems, PA. and Heglund, NC. (1998). Mechanics and energetics of human locomotion and sand. *J Exp Biol*, 201, 2071-2080.

Lussiana, T., Fabre, N., Hébert-Loiser, K., Mourot, L. (2013). Effect of slope and footwear on running economy and kinematics. *Scandinavian Journal of Medicine&Science in Sports*, 23, e246-e253.

Midgley, A. W., McNaughton, L. R., Jones, A. M. (2007). Training to enhance the physiological determinants of long-distance running performance. *Sports Medicine*, 37, 857-880.

Noakes, T. (2001). *Lore of running* (4th edition). Champaign: Human Kinetics.

Novotna, M., Simek, D., Cacek, J., Novotny, J. (2008). Running economy and aerobic capacity in distance and marathon runners. In 17th Annual Meeting of European Society of Movement Analysis for Adults and Children. Turkey.

Perl, P. D., Daoud, A. I. and Lieberman, D. E. (2012). Effects of Footwear and Strike Type on Running Economy. *Medicine&Science in Sports&Exercise*, 12, 1335-1343.

Petersen K. et al. (2007). Muscle mechanical characteristic in fatigue and recovery from a marathon race in highly trained runners. *Eur J Appl Physiol*, 101, 385-396.

Pinnington, H.C. and Dawson, B. (2001). Running economy of elite surf iron men and male runners, on soft dry beach sand and grass. *Eur J Appl Physiol*, 86, 62-70.

di Prampero, PE., Cappeli, C., Pagliaro, A., Antonutto, G., Girardis, M., Zamparo, P. and Soul, RG. (1993). Energetics of best performances in middle-distance running. *J Appl Physiol*, 74, 2318-2324.

Rodio, A., Fattorini, L., Scarcia, M., Stropiccioli, A. and Ballesio, M. (2004). Energy demand of running on football field in synthetic or natural grass. *Med Sport*, 57, 109-114.

Saltin, B. et al. (1995). Morphology, enzyme activities and buffer capacity in leg muscles of Kenyan and Scandinavian runners. *Scandinavian Journal of Medicine and science in Sports*, 5, 222-30.

Stephard, R.J. and Astrand, P.O. (2000) *Endurance in sport*. Blackwell publishing, 987 pgs.

Sassi, A., Stefaneco, A., Menaspa, P., Bosio, A., Riggio, M. and Rampinini, E. (2011). The Cost of Running on Natural Grass and Artificial Turf Surfaces. *Journal of Strength and Conditioning Research*, 25 (3), 606-611.

Saunders, P. U. et al. (2004). Factors affecting running economy in trained distance runners. *104 Sports Medicine*, 34, 465-485.

Zamparo, P., Perini, R., Orizio, C., Sacher, M. and Ferretti, G. (1992). The energy cost of walking or running on sand. *Eur J Appl Physiol Occup Physiol*, 65, 183-187.

Zamparo, P., Perini, R., Peano, C. and di Prampero, PE. (2001). The self selected speed of running in recreational long distance runners. *Int J Sports Med*, 22, 598-604.

Kinesio taping effect on biceps brachii muscle strength

Dagmar Králová, Jan Novotný, Jana Řezaninová

Faculty of Sport Studies, Masaryk University, Brno, Czech Republic

Abstract

This work aimed at presenting the idea of inventor Dr. Kenzo Kase that kinesio tape application with proximal base leads to muscle contraction facilitation and application with distal base leads to muscle contraction inhibition. Twenty male volleyball players with the dominant shoulder girdle muscle imbalance between the ages of 25 and 30 participated in this study. There were compared two techniques which were placed on biceps brachii muscle in shoulder and elbow joint extension. Isokinetic tests flexion and extension of elbow joint with HUMAC NORM were used to quantify muscle strength before kinesio taping application (first measurement), 24 hours (second measurement) and 72 hours (third measurements) after it. Third and first measurement difference was evaluated as an increase for each parameter (peak torque, average power per best repetition, angle of peak torque). The null hypothesis was not rejected for peak torque and average power per best repetition of both kinesio tape application ways but for angle of peak torque was rejected for both application methods. Kinesio tape application with both ways has statistically significant effect on angle of peak torque. On the other hand kinesio tape application don't influence peak torque or average power per best repetition. There is no statistically significant difference of both kinesio tape application methods.

Keywords: *kinesio taping, biceps brachii muscle, muscle strength, eccentric contraction.*

Introduction

In overhead athletes such as volleyball players a specific coordination between the scapula and the humerus is a key point for economical movement. Abnormal biomechanics of the shoulder blade can cause a muscle imbalance and injuries of shoulder joint too. Biceps brachii muscle is one of the muscles which connects the scapula and the glenohumeral joint. Its long caput used to be part of the rotator cuff. Biceps brachii concentric contraction is important in the end of spiking (Fig. 1C). Its eccentric contraction protects the glenohumeral joint from damage and serves as a brake of the elbow back (Fig. 1A) and close shoulder phase (Fig. 1B).

The movement is characterized with dynamic change of direction muscle pull in common life. Čáповá (2009) indicates this situation as a dynamic stabilization of support. It is prerequisite of human locomotion with other factors as an adequate motivation or a previous experience with the similar movement.

Contraction of a muscle where both its distal and proximal attachments approach one another is called concentric contraction. The direction of muscle pull depends on which end is stabilized. If the proximal muscle attachment is stabilized the distal end of the muscle moves towards proximal part. If the distal muscle attachment is fixed the proximal end of the muscle moves towards the distal part (Kolář, 2009). The similar situation arises for eccentric contraction. The muscle elongates while under tension due to an opposing force greater than the muscle generates. It acts to decelerate the joint at the end of a movement. This can occur involuntarily or voluntarily.

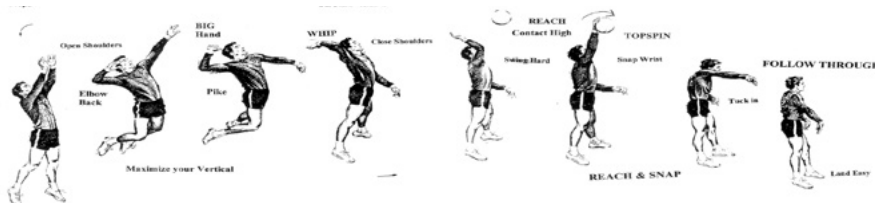


Fig. 1 Phases of Spike Approach (A – elbow back phase, B – close shoulder phase, C – track in phase)

One of the proposed methods to facilitate the control of the movement is kinesiо taping. Kinesiо tape is adapted in order to imitate skin characteristics as much as possible (Kase, Hashimoto, & Okane, 1996). In application of basic and corrective techniques, it is necessary to bear in mind that we apply or place our hands on an athlete (Kase, Wallis, & Kase, 2003). At present, there are a lot of modifications of the original Kase techniques. However, the difference between them has not quite been supported by many facts.

Several studies have supported the efficacy of kinesiо taping technique for addressing acute injury inflammation, promoting a faster return to activity, enhancing proprioception training, reducing pain, promoting neurological function postinjury and reducing muscle imbalances (Aktas & Baltaci, 2011; Halseth, McChesney, & Lien, 2004; Murray & Husk, 2001; Fu, Wang, & Lin, 2008).

This work aimed at presenting the idea of inventor Dr. Kenzo Kase that kinesiо tape application with proximal base leads to muscle contraction facilitation and application with distal base leads to muscle contraction inhibition.

Methods

Subjects

Twenty male volleyball players between the ages of 25 and 30 (mean age: $27 \pm 2,3$ yrs) participated in this study. The dominant upper limb in which there was a predisposition towards muscular imbalance in the area of the shoulder girdle was tested. Through a self-reported health history check, participants identified no known shoulder girdle or elbow pathology or upper extremity injuries. Other exclusion criteria used in this study were a history of previous shoulder surgery and a report of past skin reaction on kinesio taping material. Previous undertaking of only a conservative treatment was a prerequisite.

These participants came to our laboratory because of examination. Then we did the test on HUMAC NORM isokinetics dynamometry and applied kinesio tape two I strips on biceps brachii muscle in shoulder and elbow joint extension. The strip was led from proximal ends of biceps brachii muscle with 10% stretch to the distal end. Participants came again after one and three days and repeated the test on HUMAC NORM. We repeated this whole cycle after one month. Only difference was in application of kinesio tape Y strip. It was applied from distal part to proximal with the 10% stretch.

Kinesio taping

The skin was cleaned with alcohol before kinesio tape application on biceps brachii muscle. It was chosen according to the kinesio taping guidelines (Kase, Wallis, & Kase, 2003). There were compared two muscle techniques which were placed on biceps brachii muscle in shoulder and elbow joint extension. First one was led from proximal ends of biceps brachii muscle with 10% stretch to the distal end and second one was applied from distal part to proximal with the 10% stretch (Fig. 2).

Kinesio taping was conducted by the same physiotherapist each time in standardized form (Kase, Wallis, & Kase, 2003). After taping, the participants were asked to move with upper extremity only in functional range of movement to observe if there were any vascular problems. All the tests were explained to them before every test initiation.

Biceps brachii muscle strength

Isokinetic tests flexion and extension of elbow joint with HUMAC NORM (Fig. 3) were used to quantify muscle strength before kinesio tape application (first measurement), 24 hours (second measurement) and 72 hours (third measurements) after it. Each subject completed a standard warm up with a Thera-Band before testing. It tooks from 5 to 10 minutes.

Isokinetic testing was carried out with 5 repetitions at 60°/s, a break of 1 minute rest, and 3 repetitions at 60°/s. This medium joint speeds was recommended because of the test type which includes measurement concentric and eccentric contraction of the same muscle (Brown, 2000). Each repetition consists of concentric and eccentric biceps brachii contraction.

We evaluated peak torque, average power per best repetition and an angle of peak torque during eccentric biceps brachii contraction. *Peak torque* parameter was evaluated for comparison of concentric and eccentric figures. The eccentric figures should be 30 % higher than the concentric figures (Brown, 2000). On the other hand peak concentric force will decrease with increasing speeds, whilst, peak eccentric force will rise initially with increasing speed then plateau and eventually decrease. Using this knowledge it is possible to work out how strong a subject is related to speed and plot this on a graph (known as a force velocity curve). Measurements of *power* can highlight differences between elite performers when peak torque figures appear fruitless (Kannus, 1994). Key parameter was angle of *peak torque*. According to Kannus and Jarvinen (1990), weaker muscles probably due to neuromuscular facilitation show peak torque later in range.

Data analysis

Analysis of the differences between two types of kinesio tape application during eccentric biceps brachii contraction was performed using statistics software Statistica 8.0. Third and first measurement difference was evaluated as an increase for each parameter (peak torque, average power per best repetition, angle of peak torque). We got three date sets for kinesio tape application with the distal base and three date sets for proximal base. Measurements showed normal distribution.

First the null hypothesis was verified at the 5% significance level for each set separately. When the null hypothesis had been rejected we used the right-tail test at the 5% significance level. It confirmed that mean value of increase is greater than zero. Two types of kinesio tape application were compared through the paired t-test at the 5% significance level for each parameter.

Results

We processed results of third and first measurement difference. Results of second and first measurement difference are processed.

The null hypothesis was not rejected for peak torque and average power per best repetition of both kinesio tape application ways. There were no significant differences between measurements in time. It means that both types of kinesio tape application

don't influence peak torque or average power per best repetition. The null hypothesis was rejected for angle of peak torque of both application methods. Consequently the right-tail test confirmed that mean value of increase is greater than 0. Kinesio tape application with both ways has statistically significant effect on angle of peak torque and can support weaker muscles.

The paired t-test at the 5% significance level for each parameter compared two types of kinesio tape application. These tests confirmed that mean values of each parameter are equivalent. So there is no statistically significant difference of both kinesio tape application methods.

Discussion

Existing studies still include many unknowns mainly regarding process of the kinesio tape application and its influence on muscular activity. Alexander et al. have dealt with inhibition effect of the tape and kinesio tape applied along muscle fibre of trapezius and triceps surae muscle in their studies. Individual muscles were taped autonomously and it has been concluded that kinesio tape has no effect on muscular activity (Alexander, McMullan, & Harrison, 2008; Alexander, & Harrison, 2003).

Herzeele et al. (2013) evaluated kinesio tape effect through 3-dimensional scapular motion measurements during humeral elevation in the sagittal, frontal and scapular plane. The results showed that kinesio taping has moderate to large effect towards scapular posterior tilting, in all 3 planes of humeral movement and for all angles of elevation. Kinesio taping also moderately increased the scapular upward rotation at 30°, 60° and 90° of humeral abduction (Herzeele, Cingel, & Cools, 2013).

Kase et al. mention the direction of taping in their work. In case of traction from the start of the muscle to its insertion, muscle contraction is facilitated; in case of traction in the opposite direction, it is inhibited (Kase, Wallis, & Kase, 2003). However, here is an issue of whether to regard punctum fixum for the stepping forward movement aspect or for the supporting function provision. Other key point is type of contraction.

Important factor is the length of the kinesio tape application process. In order for the length of stimulation of soft tissues or the entire organism to be sufficient, it is necessary to leave the tape on the applicable spot for three to four days. This should be followed by at least two-day's break (Kase, Wallis, & Kase, 2003). However Slupik et al. (2007) have recorded the greatest effect of the tape in terms of increase of muscular tension 24 hours from its application and then 48 hours after its removal (application length: 24 hours).

It is also necessary to consider the extent of traction of the kinesio tape. In their studies, Kase et al. warn that less traction is sometimes more (Kase, Hashimoto, &

Okane, 1996, Kase, Wallis, & Kase, 2003). Unfortunately, many studies do not state the extent of traction used. According to Vrbová et al. Itoha et al. have proven that a kinesio tape with maximum tension applied along fibres onto the lateral side of knee joint decreases latency of the hamstring stretching reflex (Itoh, Hayashi, & Kubota, 2004; Vrbová, Pavlů, & Pánek, 2011).

The condition of the organism plays a crucial role in measuring of muscular activity. The effect on a healthy organism and on an organism with a disorder resulting in muscular imbalance may be the same, but efficiency may vary or sometimes even be opposite (Aktas & Baltaci, 2011; Fu, Wang, & Lin, 2008; Vrbová, Pavlů, & Pánek, 2011).

Conclusions

Results of third and first measurement difference showed that kinesio tape application with both ways has statistically significant effect on angle of peak torque. On the other hand kinesio tape application don't influence peak torque or average power per best repetition. There is no statistically significant difference of both kinesio tape application methods.

When we evaluated results of previous researches and ours we have an idea that kinesio taping influences quality of muscle tissue. Muscle strength is influenced with many factors as muscle tissue quality or motor control. Therefore, we would like to proceed in this direction.

References

- Aktas, G., & Baltaci, G. (2011) Does kinesiotaping increase knee muscles strength and functional performance? *Isokinetics and Exercise Science* 19, 149-155.
- Alexander, C. M., McMullan, M., & Harrison, P. J. (2008) What is the effect of taping allong or across a muscle on motoneurone excitability? A study using Triceps Surae, *Manual Therapy* 13, 57-62.
- Alexander, C. M., & Harrison, P. J. (2003) Does tape facilitate or inhibit the lower fibres of trapezius? *Manual Therapy* 8(1), 37-41.
- Brown, L. E. (2000) *Isokinetics in Human Performance*, 1st ed. Champaign: Human Kinetics Publishers.
- Čápková, J. (2008). *Terapeutický koncept "Bazální programy a podprogramy"*, 1. vyd. Ostrava: Repronis.
- Fu, T. C., Wang, A. M., & Lin, Y. C. (2008) Effects of Kinesio taping on muscle strength in athletes. A pilot study. *J Sci Med Sport* 11, 198-201.
- Halseth, T., McChesney, J. W., & Lien, J. (2004) The effects of Kinesio taping on proprioception at the ankle. *J Sport Sci Med* 3, 1-7.
- Herzele, M., Cingel, R., & Cools, A. (2013) Does the Application of Kinesiotape Change Scapular Kinematics in Healthy Female Handball Players? *International Journal of Sports Medicine* 34, 950-955.
- Hutson, M., & Speed, C. (2011) *Sport Injuries*, 1st ed. New York: Oxford.
- Itoh, Y., Hayashi, T., & Kubota, T. (2004) Localized short elastic tape affect the hamstring reflex on anterior cruciate ligament deficient knee, *Bulletin of the Osaka Medical College* 50 (1,2).
- Kannus, P. (1994) Isokinetic Evaluation of Muscular Performance, *International Journal of Sports Medicine* 15, S11-S18.
- Kannus, P., & Jarvinen, M. (1990) Knee flexor / extensor strength ratio in follow up of acute knee distortion injuries, *Archives of physical medicine and rehabilitation* 71, 38-41.

Kase, K., Hashimoto, T., & Okane, T. (1996) Kinesio Taping Perfect Manual amazing taping therapy to eliminate pain and muscle disorders, 1. vyd. Albuquerque, NM: KMS, LLC.

Kase, K., Wallis, J., & Kase, T. (2003) Clinical Therapeutic Applications Of The Kinesio Taping Method, 1. vyd. Albuquerque: KMS, LLC.

Kolář, P. (2009). Rehabilitace v klinické praxi (1st ed.). Praha: Galén.

Murray, H., & Husk, L. (2001) Effect of kinesio taping on proprioception in the ankle. J Orthop Sports Phys Ther 31, A-37.

Slupik, A., & Zych, E. (2007) Effect of kinesio taping on bioelectrical activity of vastus medialis muscle. Preliminary report, Ortopedia Traumatologia Rehabilitacja 9(6), 644-651.

Vrbová, M., Pavlů, D., & Pánek, D. (2011) Vliv tapu aplikovaného v průběhu svalových vláken na svalovou aktivitu pod ním ležícího svalu. Rehabilitace a fyzikální lékařství 18(2), 87-96.

A current literature review Actual concepts and contemporary scientific interests in sport nutrition

Michal Kumstát

Faculty of Sport Studies, Masaryk University, Brno, Czech Republic

Abstract

It has been well established, that specific nutritional strategies before, during and after exercise maximise physical performance and adaptive training outcomes. It is evident that several nutritional concepts such as the role of nutrition in facilitating the skeletal muscle adaptive response to exercise or studies exploring ergogenic potential of β -alanine and bicarbonate supplementation are of considerable scientific interest. Additionally, the ergogenic potential of mouth-rinsing with carbohydrate solutions has been well documented. From this perspective, the aim of the review-article is to consider some of the present-day sport nutrition scientific topics. Promotion of training adaptations, such as endurance training in glycogen depleted state, performance enhancement potential of novel ergogenics and dietary regimens will be discussed. Real sport environment and practical recommendations will be particularly strengthened. The scientific programmes of the latest 13 sport nutrition conferences held in 2007-2013 were analysed in detail. The topics that were debated the most, suggesting concurrent considerable scientific attention, were selected. Ingestion of protein and carbohydrate plays a key role in post-exercise muscle recovery. Specifically, it has been recognized that leucine occupies a prominent position among other amino acids and may be critical in enhancing mTOR-mediated muscle adaptation and post-exercise recovery. Similarly, manipulating with carbohydrate availability via train-low compete-high strategy has been shown to induce metabolic adaptations, involving enhanced muscle activities of several mitochondrial enzymes. The novel endurance performance enhancing concept of carbohydrate mouth-rinsing has been presented with robust scientific support. Bicarbonate supplementation has been reported to enhance acute intermittent high-intensity exercise performance. However practical considerations for bicarbonate loading still remain to be established and further benefits can be individualised for specific events. Likewise, β -alanine as a precursor of intracellular buffering agent carnosine is another ergogenic attracting recent research. Nutritional strategies modulate the adaptive response either to endurance, or resistance training. Protein ingestion in the amount of 20-25 g facilitates post-exercise skeletal muscle adaptive response. This may modify training efficiency via muscle reconditioning. Additionally, whether manipulating with carbohydrate availability improves exercise performance remains unclear, despite the fact it enhances muscular adaptive response.

With increasing evidence, both bicarbonate loading and β -alanine ingestion appears to act as nutritional strategies enhancing performance during high intensity exercise. Mouth rinse with a carbohydrate solution is a novel nutritional regimen attracting recent research. It is necessary, that all evidence-based, though theoretical proposals and conclusions are clearly translated into the real training and/or competition practise.

Keywords: *Sport nutrition, adaptation, carbohydrate availability, carbohydrate mouth rinse, β -alanine, bicarbonate.*

The work was supported by European operational program Education for Competitiveness Cz.1.07/2.4.00/17.0039, Creation of a Network of Professional Institutions Participating in the Fight against the Occurrence of Metabolic Syndrome.

Introduction

It is clear that nutrition is one of the key elements of the serious athlete's preparation. Diet affects performance and proper training or competition nutrition might directly promote adaptations in muscles and other tissues in response to the exercise stimulus. It has been well established, that specific nutritional strategies before, during and after exercise maximise physical performance and adaptive training outcomes. It is evident that several nutritional concepts such as the role of nutrition in facilitating the skeletal muscle adaptive response to exercise or studies exploring ergogenic potential of β -alanine and bicarbonate supplementation are of considerable scientific interest. Additionally, the ergogenic potential of mouth-rinsing with carbohydrate solutions has been well documented recently. The aim of the paper is to overview some of the present-day sport nutrition scientific topics. Promotion of training adaptations, such as endurance training in glycogen depleted state, performance enhancement potential of novel ergogenics and dietary regimens will be discussed.

Methods

The scientific programmes of the latest 13 sport nutrition conferences¹ held in 2007-2013 were analysed in detail. The topics that were particularly debated and highlighted on the conferences, suggesting concurrent considerable scientific attention, were selected.

Results and discussion

Train low-compete high nutritional strategy

The study of Hansen et al. (2005) imposed extreme interest in the hypothesis of “*train low, compete high*” model. The researchers demonstrated that training with low glycogen content might promote metabolic adaptations. Several other investigations confirmed that resting muscle glycogen concentrations, rates of whole body fat oxidation or muscle activities of mitochondrial enzymes citrate synthase and beta-hydroxyacyl-CoA-dehydrogenase were potentiated, when training was undertaken with low glycogen (Burke, 2010). Hawley (2013) summarizes that, regardless the prior training status, short term (< 10 weeks) training programmes in which some workouts are commenced with low glycogen and/or low exogenous glucose availability promote mitochondrial enzymes activity and mitochondrial biogenesis to a greater extent in comparison to the normal or elevated glycogen stores. Despite the fact that periodic training with reduced glycogen and/or exogenous glucose availability promotes muscle adaptations, Hulston et al. (2010) and other investigators found that this does not translate into performance improvements.

The role of protein in skeletal muscle adaptation

Protein and/or amino acids ingestion stimulates muscle protein synthesis and inhibits muscle protein breakdown. The stimulatory effect is mainly due to the subsequent postprandial increase in amino acid availability. The role of the molecular processes that act in a protein synthesis attract considerable attention. We know that the rate of myofibrillar protein synthesis is controlled by a protein called mTOR². The importance of the protein mTOR in muscle growth and specifically how amino acids modify the responses has been intensively investigated. Recently, amino acid leucine has been suggested to be essential in turning on mTOR (Han et al., 2012). The form of dietary protein should be rapidly digested and rich in leucine (e.g. whey protein). The amount of protein that is needed to consume reaches ~ 20–25 g, and it should be consumed either before or immediately after exercise. However, regarding that the stimulatory effect manifested primarily in myofibrillar biogenesis, it is not clear whether protein intake improves the adaptation to endurance exercise (Aguirre, van Loon, & Baar, 2013). Breen et al. (2011) showed that consuming protein following endurance exercise does not further increase mitochondrial protein synthesis.

Carbohydrate solution mouth-rinse

Carbohydrate loading, the use of caffeine and creatine hold the most evidence-based support of being ergogenic. Recent works strongly confirmed carbohydrate mouth-

rinsing to enhance work capacity as well. Carter, Jeukendrup, & Jones (2004) were first to show, that mouth-rinsing with 6,4 % maltodextrin solution enhances 1h cycle time trial performance. Since that report, most investigations have reported endurance performance benefits. The majority of studies have been conducted in cyclists and runners. The subjects during the endurance exercise task (usually time trial) were asked to rinse the mouth with a given carbohydrate solution without swallowing any of it. The exact mechanisms to explain the ergogenic effect of mouth rinsing during exercise are not clear. However, the study of Chambers, Bridge, & Jones (2009) suggest that the improvement in exercise performance might be explained by the activation of brain regions thought to be involved in reward and motor control. The authors also suggest that there may be a class of so far unidentified oral receptors that respond to carbohydrate independently of those for sweetness. Current available literature is consistent in conclusion that mouth rinse with ~ 6 % carbohydrate solution during exercise can have a beneficial effect on endurance performance of ~1h in duration in fasted subjects. In contrast, studies focusing on multiple sprint effort exhibited no performance improvements (Dorling & Earnest, 2013). It must be noted that the performance response to the mouth-rinse appears to be dependent upon the pre-exercise nutritional status of the subjects (Rollo & Williams, 2011). The information of the performance benefits from mouth rinsing for endurance athletes has been even integrated in the “Nutrition for athletes” booklet prepared by the Medical Commission Working Group on Sports Nutrition of the International Olympic Committee (revised and updated in preparation for the London Olympic Games in April 2012).

Buffering agents

Maintaining acid-base balance is a major challenge during anaerobic type of exercise. Due to the massive H⁺ production, the pH within the muscle cells and subsequently in the circulation can drop rapidly. The body’s capacity to manage the progressive increase in both extracellular and intracellular acidity is limited. Bicarbonate has been proposed to attenuate extracellular acidosis during high-intensity bouts of exercise. Newer strategy includes the use of β-alanine as an alternative intracellular buffering agent.

Consumption of sodium bicarbonate or another alkalizing agent, such as sodium citrate in the amount ~ 180-300 mg/kg 1-2 h before exercise can temporarily increase blood bicarbonate concentrations, enhancing extracellular buffering capacity. Such ‘bicarbonate loading’ provides an ergogenic strategy for events involving high rates of anaerobic glycolysis, such as middle-distance swimming, middle-distance running or rowing events (Burke, 2013; Derave, Everaert, Beeckman, & Baguet, 2010). Similarly, repeated-sprint performance, i.e. frequent repetition of high-intensity periods followed

by periods with lower intensity lasting overall ~30-60 min, typical for majority of team sports may therefore be enhanced by improved buffering as well (Burke, 2013). One way to tackle the acidosis is to induce alkalosis artificially via bicarbonate loading prior to the start of exercise. Beta-alanine, in contrast is studied in relation to the ergogenic potential despite having no buffering capacity. It is a rate-limiting precursor in the synthesis of carnosine (dipeptide composed of histidin and β -alanine). Carnosine acts as an intracellular buffer within the muscle cells. Although the contribution of carnosine to the overall buffering capacity is rather limited (10 %), it attracts considerable interest among sport-nutrition scientists (Stellingwerff, Decombaz, Harris, & Boesch, 2012). Concentration can be nutritionally altered, which was firstly demonstrated by Harris et al. (2006). Since that report, it has been well documented that β -alanine induced muscle carnosine loading significantly impacts pH buffering capacity during ~ 6min high intensity exercise (Baguet, Koppo, Pottier, & Derave, 2010). Carnosine levels in muscle are elevated by 50-80 % by ingesting ~ 4-6 g/day of β -alanine during 4-10 consecutive weeks (Derave, 2013). A unique metaanalysis of the effects of β -alanine on performance revealed a # 2,85 % improvements in performance when 179 g of β -alanine was consumed over 4 weeks of duration. Not surprisingly, the strongest effect was in exercise tests lasting 1-4 min, with no benefit during sprint based protocols (< 60 s of duration) (Hobson et al., 2012). Although the actual evidence for an additive effect of β -alanine and bicarbonate is not validated, Derave (2013) has suggested a theoretical framework which could explain possible additivity.

Conclusions

Nutritional strategies modulate the adaptive response either to endurance, or resistance training. Dietary protein ingestion in the amount of 20-25 g and rich in leucin facilitates post-exercise skeletal muscle adaptive response. Many athletes intentionally commence specific workouts with either low muscle glycogen reserves and/or low exogenous carbohydrate availability. Such strategy is based on reports that demonstrated when endurance-based training sessions are commenced with low-glycogen availability training adaptation is augmented to a greater extent than when similar workouts are undertaken with normal glycogen stores. A well-established way to overcome the acidosis is to induce alkalosis prior to the start of the exercise by pre-exercise ingestion of sodium bicarbonate in a dose of ~ 180-300 mg/kg. This strategy is proved to be successful in enhancing performance in single or repeated high-intensity exercise bouts. Both carnosine levels via β -alanine ingestion (i.e. first line defence) and bicarbonate (i.e. second line defence) could be nutritionally alleviated and could lead to performance-enhancing effects during high intensity exercise.

Mouth rinse with a carbohydrate solution is a novel nutritional regimen with solid scientific evidence for endurance performance enhancement. From a practical point of view, it must be however noted, that the majority of performance-enhancing findings (e.g. mouth rinsing, bicarbonate and β -alanine supplementation) was generally verified in recreationally trained males. Whether findings could be extrapolated to the elite athletes, remains controversial. Above that, it is necessary that all evidence-based, though theoretical proposals and conclusions are clearly translated into the real training and/or competition practise.

Reference

- Aguirre, N., van Loon, L. J. C., & Baar, K. (2013). The role of amino acids in skeletal muscle adaptation to exercise. Nestlé Nutrition Institute workshop series, 76, 85-102.
- Baguet, A., Koppo, K., Pottier, A., & Derave, W. (2010). Beta-alanine supplementation reduces acidosis but not oxygen uptake response during high-intensity cycling exercise. *European journal of applied physiology*, 108(3), 495-503.
- Breen, L., Philp, A., Witard, O. C., Jackman, S. R., Selby, A., Smith, K., Tipton, K. D. (2011). The influence of carbohydrate-protein co-ingestion following endurance exercise on myofibrillar and mitochondrial protein synthesis. *The Journal of physiology*, 589(Pt 16), 4011-4025.
- Burke, L. M. (2010). Fueling strategies to optimize performance: training high or training low? *Scandinavian journal of medicine & science in sports*, 20 Suppl 2, 48-58.
- Burke, L. M. (2013). Practical considerations for bicarbonate loading and sports performance. Nestlé Nutrition Institute workshop series, 75, 15-26.
- Carter, J. M., Jeukendrup, A. E., & Jones, D. A. (2004). The effect of carbohydrate mouth rinse on 1-h cycle time trial performance. *Medicine and science in sports and exercise*, 36(12), 2107-2111.
- Derave, W. (2013). Use of β -alanine as an ergogenic aid. Nestlé Nutrition Institute workshop series, 75, 99-108.
- Derave, W., Everaert, I., Beeckman, S., & Baguet, A. (2010). Muscle carnosine metabolism and beta-alanine supplementation in relation to exercise and training. *Sports medicine (Auckland, N. Z.)*, 40(3), 247-263.
- Dorling, J. L., & Earnest, C. P. (2013). Effect of carbohydrate mouth rinsing on multiple sprint performance. *Journal of the International Society of Sports Nutrition*, 10(1), 41.
- Han, J. M., Jeong, S. J., Park, M. C., Kim, G., Kwon, N. H., Kim, H. K., Kim, S. (2012). Leucyl-tRNA synthetase is an intracellular leucine sensor for the mTORC1-signaling pathway. *Cell*, 149(2), 410-424.

Hansen, A. K., Fischer, C. P., Plomgaard, P., Andersen, J. L., Saltin, B., & Pedersen, B. K. (2005). Skeletal muscle adaptation: training twice every second day vs. training once daily. *Journal of applied physiology* (Bethesda, Md.: 1985), 98(1), 93-99.

Harris, R. C., Tallon, M. J., Dunnett, M., Boobis, L., Coakley, J., Kim, H. J. Wise, J. A. (2006). The absorption of orally supplied beta-alanine and its effect on muscle carnosine synthesis in human vastus lateralis. *Amino acids*, 30(3), 279-289.

Hawley, J. A. (2013). Nutritional strategies to modulate the adaptive response to endurance training. *Nestlé Nutrition Institute workshop series*, 75, 1-14.

Hobson, R. M., Saunders, B., Ball, G., Harris, R. C., & Sale, C. (2012). Effects of β -alanine supplementation on exercise performance: a meta-analysis. *Amino acids*, 43(1), 25-37.

Chambers, E. S., Bridge, M. W., & Jones, D. A. (2009). Carbohydrate sensing in the human mouth: effects on exercise performance and brain activity. *The Journal of physiology*, 587(Pt 8), 1779-1794.

Rollo, I., & Williams, C. (2011). Effect of mouth-rinsing carbohydrate solutions on endurance performance. *Sports medicine (Auckland, N.Z.)*, 41(6), 449-461.

Stellingwerff, T., Decombaz, J., Harris, R. C., & Boesch, C. (2012). Optimizing human in vivo dosing and delivery of β -alanine supplements for muscle carnosine synthesis. *Amino acids*, 43(1), 57-65.

The effect of caffeine administration on endurance performance using the Borg scale

Ondřej Smolka, Michal Kumstát, Iva Hrnčířiková, Martin Sebera
Faculty of Sport Studies, Masaryk University, Brno, Czech Republic

Abstract

This work deals with the use of the Borg scale, as a tool for measuring the rate of perceived exertion (RPE) during the caffeine-affected endurance performance. The aim is to compare the RPE during three experimental trials with prior caffeine (CAFF) ingestion – placebo, 0 mg/kg b.w.; CAF1, 2 mg/kg b.w. and CAF2, 7 mg/kg b.w. Furthermore, it is focused to assess whether RPE might be used to define the long-term effect of caffeine on endurance. Ten sub elite cyclists (27.7±4.1 y, body weight 77.6±8 kg, VO₂max: 56.9±6.6 ml/min) participated on a randomized, double-blind crossover study. Within one month the subjects follow the experimental measurements, consisted of a ride on a bicycle ergometer (60min 70% VO₂max followed by gradual test to exhaustion). Subjective RPE values were determined using the Borg 20-category scale. When comparing the results we found the significant difference (0.008356) between PLA and CAF2 experimental measurements (p0.05). Level of substantive significance was assessed using the Cohen's coefficient effect and was found only small "size of effect" (0.19). The results of comparison of the experimental situations using the Borg scale are not persuasive. It is therefore not possible to determine whether using the Borg scale might be used to define the effects of caffeine ingestion on endurance performance, due to the multifactorial effects of caffeine. We recommend using the Borg scale only as an additional indicator of exercise intensity in exercise training.

Keywords: Caffeine, Borg scale (RPE), endurance performance, cycling.

Introduction

Caffeine is a natural component of many foods and beverages available to the general public. Caffeine is a stimulant that has a number of physiological and psychological effects. For this reason, it is widely used as a food supplement in the manufacture of sports nutrition. For many athletes, caffeine is part of the dietary regime. Its application is found before or during the competition, and the training effect of caffeine is dependent on its source, adopted quantity dosage, sex, nutritional status of the individual and other factors (Burke, L. M. (2008)). The influence of

caffeine on the human body is studied in relation to the possible improvement of sports performance. The body has a number of effects associated with the direct influence on performance – stimulation of the central nervous system; increasing cAMP and influence on the activity of adrenaline are associated with increased lipolysis in adipose and muscle tissue, thereby increasing the availability of energy substrates to working muscles. This glycogen sparing potential is not the only mechanism explaining the ergogenic effect of caffeine. There is evidence of an increase in performance after caffeine without affecting the oxidation of nutrients. This indicates a highly variable physiological response between individuals. Caffeine is known to affect fatigue perception (figure 1). The aim of the contribution is to determine the acute effect of CAF ingestion on endurance performance via the rate of perceived exertion (RPE) by using the Borg scale.

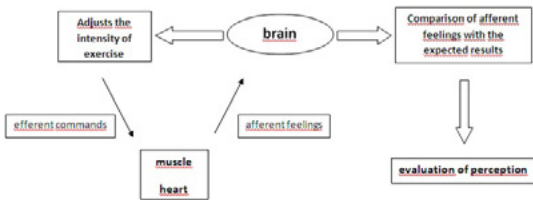


Fig. 1 Regulation of predetermined intensity exercise (adapted from Hampson, Gibbon, Lambert & Noakes, 2001)

Methods

Ten male subjects, sub elite cyclist (27.7 ± 4.05 y, body weight 77.6 ± 8.0 kg, VO_{2max} 56.9 ± 6.6 ml/min) completed the randomized, crossover, double-blind study. The experimental measurements were preceded by the maximal oxygen consumption test (VO_{2max}). During the following three non-consecutive days (within 1 month) participants completed three identical experimental tests (60min drive, 70 % VO_{2max} followed by test to exhaustion). All tests were completed on a software controlled bicycle ergometer using cardio metabolic unit Cortex MetaLyzer 3B. Three experimental liquid meals (combination of water, gel supplement and specific dose of anhydrous form of CAF): placebo (PLA, no caffeine), CAF1 (2 mg/kg.b.w.) and CAF2 (7 mg/kg.b.w) were administered 45min prior to the start of the experimental tests. Rating of perceived exertion was determined during the measurements at a 2min interval using the Borg scale. Time to exhaustion was measured during each trial. Participants were excluded if they were smokers, took medications that would affect physical performance

or metabolism, or lacked the ability to perform the laboratory tests or participate in moderate-intensity exercise. Each participant was asked to follow a particular specific pre testing carbohydrate – rich diet (8 g carbohydrate per b.w) to eliminate the possible detrimental effects of the experimental measuring. Finally, participants were given instructions about caffeine-containing food and beverages and asked to abstain from caffeine ingestion at least 72 hours before the experimental measuring.

Tab. 1 Characteristics of the participants

Parameter	Mean ± Standard deviation	Range
Age (years)	27.7±4.1	22-35
Height (cm)	181.4±7.9	168-191
Body weight (kg)	77.6±8.0	68-91.7
VO ₂ max. (ml/kg)	56.9±6.6	50-67

Results

A multi-factor analysis of variance (ANOVA) was used to examine interactions and main effects using the RPE as a covariate. Significance was set at $p < .05$. All analyses were performed using the Statistica 12th software

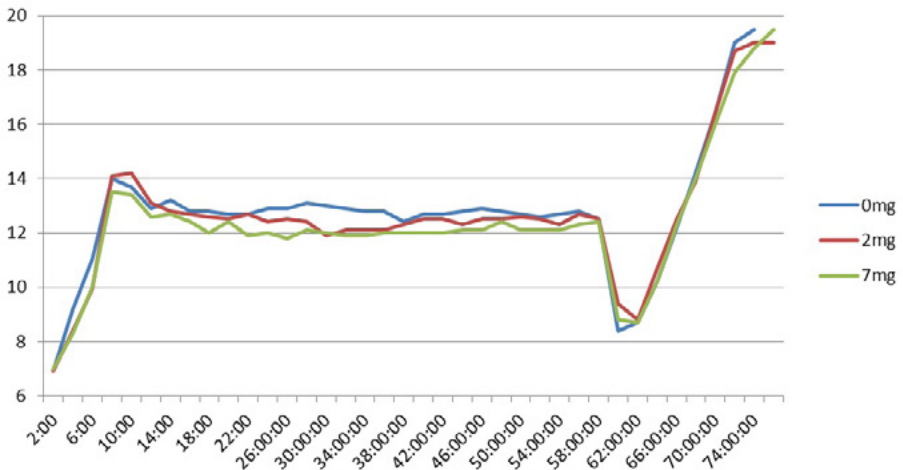


Fig. 2 Measurements results of Rating of Perceived Exertion (RPE)

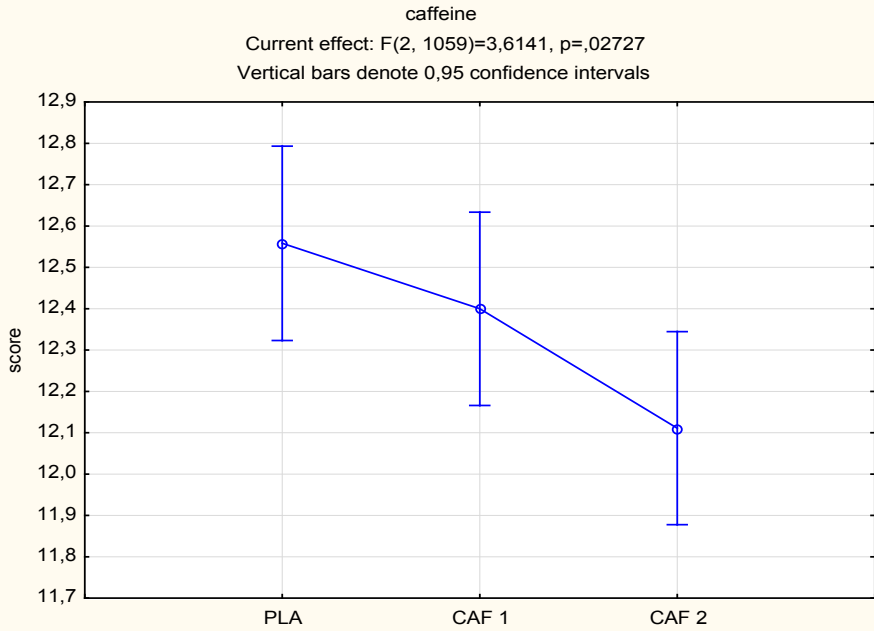


Fig. 3 Box plot results of RPE

The result of ANOVA detected a statistically significant difference, as confirmed by Fisehr’s post-hoc LSD test. Statistically signifiant difference was found between PLA and CAF2. (Tab. 2)

Tab. 2 Results of Fisher’s LSD test

Cell No.	LSD test; variablescore Probabilitiesfor Post Hoc Tests Error: Between MS = 5.1638, df = 1059.0			
	caffeine	{1} 12.558	{2} 12.401	{3} 12.112
1	PLA		0.352124	0.008356
2	CAF 1	0.352124		0.086538
3	CAF 2	0.008356	0.086538	

The level of substantive significance (“sizeofeffect”) was assessed using Cohen’s d effect coefficient (Cohen, 1994), which shows the relative chase of the average variable with respect to the standard deviation of measurements in the group. We consider the difference PLA and CAF2 is materially significant. (Tab. 3)

Tab. 3 Cohen’s d results

kodefin	Cohen d
PLA and CAF1	0.06
PLA and CAF2	0.19
CAF 1 and CAF2	0.12

The primary aim of this paper was to examine the effect of three specific doses (PLA, CAF 1, and CAF 2) on long-term endurance performance. Data revealed significant difference between PLA and CAF2 ($p > 0.05$). The level of substantive significance was assessed using Cohen’s coefficient effect and has been demonstrated only small “size of effect” (0.19).

The ergogenic potential of caffeine on endurance performance lasting approximately 1 hr have been well documented and summarised in many recent reviews (Burke, 2008; Doherty and Smith, 2004; Ganio et al., 2009). Interestingly Beedie et al. (2008) demonstrated that placebo effects are associated with the administration of caffeine even in dosage (9 mg /kg b.w.) and that these effects may directly or indirectly enhance performance in well-trained cyclists.

Conclusion

The aim of the contribution was to determine the acute effect of CAF ingestion on endurance performance via the rate of perceived exertion (RPE) and using the Borg scale. The results of comparison of the experimental situations using the Borg scale are not persuasive. It is therefore not possible to determine whether using the Borg scale might be used to define the effects of caffeine ingestion on endurance performance, due to the multifactorial effects of caffeine.

Reference

Beedie, C., Stuart, E., Coleman, D., Foad, A. (2006). Placebo effects of caffeine on cycling performance. *Medicine and Science in sports and Exercise*, 38 (12), 2159-2164.

Borg, G. (1982). Category scale with ratio properties for intermodal and interindividual comparisons. In H.G. Geisler and P. Petzold (Eds.), *Psychophysical judgment and the process of perception* (pp 22-33). Berlin: North-Holland.

Burke, L. M. (2008) Caffeine and sport performance. *Journal of Applied Psychology Nutrition and Metabolism* 33 (6), 1319-1334.

Cohen, J. (1994) The Earth is round, *American Psychologist* 49 (5), 997-1003.

Doherty, M., Smith, P. (2004) Effect of caffeine ingestion on exercise testing: A metaanalysis. *International Journal of Sport Nutrition and Exercise Metabolism*, 14, 626-646.

Ganio, M. S., Klau, J. F., Casa, D. J., Armstrong, L. E., Maresh, C. M. (2009). Effect of caffeine on sport-specific endurance performance: A systematic review. *Journal of Strength and Conditioning Research* 23 (1), 315-324.

Hampson, D. B., Gibbon, A. C., Lambert, M. & Noakes, T. D. (2001). The influence of sensory cues on the perception of exertion during exercise and central regulation of exercise performance. *Sports Medicine*, 31(13), 935-952.

**SPORT IN THE PERSPECTIVE
OF SOCIAL SCIENCES**

The Spirituality of Movement Activities in the Context of Philosophical Kinanthropology

Emanuel Hurych

Department of Sports, College of Polytechnics, Jihlava, Czech Republic

Abstract

This article aims to introduce a secularized approach to spirituality in the field of sport and human movement. Spirituality in this sense brings a new hope for the development of human spirit and it also opens the possibilities for some new approaches in kinanthropological investigations. This text presents a theoretical study of the spirituality of movement activities from the philosophical point of view.

This spiritual model is based on these aspects: awareness and appreciation of the other, the capacity to respond to the other and developing significant life meaning. The author emphasises that a spiritual approach to sport is a good chance how to solve some problems of the modern sport. Spirituality is also about finding life meanings that will carry us through all sorts of experiences, including those that challenge our faith and hope. And sport can be a part of this.

The author believes that the topic of the spirituality of movement activities will become a more frequent theme of the serious studies in kinanthropology. Via this we can try to search for a deeper sense and a more versatile perception of movement activities at all.

Keywords: *Secularization, sport, mathematization, positivism, esoterism.*

Introduction

The first aim of this article is to introduce a secularized approach to spirituality in the field of sport and physical activities. Here it is necessary to explain why spirituality in this sense should be considered as a suitable and profitable approach to physical activities at all.

We argue that this model brings a new hope for the development of human spirit. It also opens the possibilities for some new approaches in kinanthropological investigations, especially in the field of qualitative research. Where could we find the reasons for this conviction? They can be introduced sequentially. First it is necessary to point out that there can be watched a very deep crisis of the elite sport in a last few years. Doping scandals which has been accompanying Tour de France recently, as well as the Jamaican sprinters in 2013, or the corruption affairs in the Czech Gambrinus Football League 2012 and 2013 are only tips of the iceberg. Modern sport

becomes more and more technical and mechanical, more and more dependent on exact measurements. The effort to reach best performances evaluated in figures and numbers is increasingly needed. Financial issues and business aspects play the key role not just as a support of sport activities but they also often change their character and some processes which are connected with sport events. Some sport sociologists contend that it brings more negative aspects in sports such as sledging, unfair play, throwing a match away and other vices. "All these are done to succeed by all means because of financial aspect associated with winning or losing a match being in the form of financial contract, endorsement and advertisements" (Dhokrat, 2012, 41).

Spirituality can help us to bring the *eidos* (the essence) of sport back. This is not just a naive idealistic vision or an empty likable phrase. It is necessary to renew the spirit of sport and return to some values and virtues which are typical for physical activity at all and which sport comes from (Hurych et al, 2013). How can it be possible to re-discover a spirit of sport via spirituality? It is the main theme of this article.

Methods

This text presents a theoretical study of the spirituality of movement activities. The study comes from the philosophical point of view. Nevertheless, the pure philosophical abstraction has to be confronted with some empirical experience. That is why the article uses some theological and sociological approaches as well. It tries to interconnect all of them into one versatile and harmonised result. We would like to propose a model of secularized spirituality.

The reason why the attention should be paid here is that the contemporary studies in majority cases come either from the religious approach (Kahan, 2002; Joslin, 2004; Saint-Sing, 2004; Preece & Hess, 2006), or from primarily secular ones which are based on the ideas of Max Scheler, Abraham Maslow, Mihály Csikszentmihalyi, Hans-Georg Gadamer and other thinkers, or on some studies provided by Elkins et al. (1988), Zinnbauer et al. (1997) etc. In the Czech setting we can find more and more works about secular spirituality (for instance Štampach; 2010, 2013). Our aim is to explain the secularized (or even secularizing) spirituality in its main characteristics and to describe its major features. It is very important to understand the sense of this model in common in order to be able to understand its application in the sphere of sport.

The second aim of the article is to explain how this model can be applied in the field of sport and what the results of this application can be. Here some concrete examples were used to clarify this approach and to explicate possibilities which this potential contains. For this reason we decided to use two diagrams displaying the structure of links which are interconnected and related.

Results

The secularized spirituality

Spirituality within this presented model is secularized. This approach doesn't deny the religious roots which present sources of spirituality for a lot of centuries. However, it can develop them within the modern conditions. This fact is more important in the Czech Republic where the population is very (or better extremely) secular. Spirituality is not introduced as something esoteric here. It is described as a method of the prevention from the positivism on one hand and esoterism on the other hand.

The spiritual model presented here is based on these aspects of human spirit: awareness and appreciation of the other (including the self, the other person, the group, the environment and deity in a wide meaning); the capacity to respond to the other (which involves putting spirituality into practice, embodying spirituality, and thus the continued relationship with the other); developing significant life meaning based upon all aspects of awareness and appreciation of and response to the other (Robinson & Parry, 2013, 18). The Fig. 1 displays the main relations which have to be described.

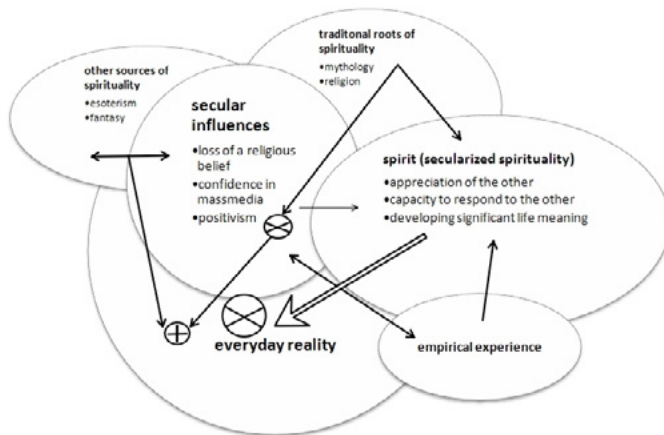


Fig. 1 Secularized spirituality in a structural scheme

Not all the existing relations are included since any of them can be linked to each other in some way. However, for the understanding of our conception the major links are emphasized here. We can see that in this flowchart the secularized spirituality (the eidos of spirit) comes from the traditional roots and from the empirical experience, especially. The secular influences also penetrate into this field but not so strongly.

That is why we speak about secularized (not secular) spirituality. We can notice that the traditional roots of secularity are caught and transformed in the sphere of secular influences through which they have to get to the field of everyday reality. They are decreased and deformed here.

The lack of a spiritual perception (that means the loss of humanity) is compensated with the positivistic viewing of the world and with some esoteric expositions of spirituality. It means that a power of extreme positivism is multiplied by an esoteric compensation of the real spiritual perception. Traditional spirituality is pushed back this way. Especially, that is true if its most influential spiritual declaration – the religious spirituality (based on Christianity) – loses its position of the ideological leader of the society. On the other hand, some religionists (for example Ivan Štampach) point out that the traditional division – into believers and non-believers – loses its sense these times. There are a lot of modern approaches in which the old concepts of religion were changed and transformed (Štampach, 2013). What is important – a lot of people reject a religious approach not for its ideological basis but for its institutional character (connected with some duties, ceremonials, rituals, artefacts etc.).

In the diagram (Fig. 1) we can follow how the everyday reality is filled with the positivistic approach which picks up and joins esoteric forms of spirituality into one powerful stream of influence. This one can be manipulative because it supports the mechanical acceptance of various phenomena and events presented in the form of exact data. The function of esoteric forms of spirituality is mainly compensative and diversionary. That is the reason why they support the domination of mechanical approach to the world. As the opposite, the emphasis on human spirit (in this case in the form of secularized spirituality) presents a kind of prevention from it.

Spirituality and sport

In the world of sport we can see a lot of examples of extremely mechanical approaches. Some measurements of the exact data and a required sport performances based on results in centimetres and seconds threaten with the robotic understanding of sportsmen's role in this enterprise. This is supported with some financial dependence on this measured data (dependence of all the participants – sportsmen, spectators, organizers etc.). The other extreme is presented by a superstitious approach to sport. It means some spectacular rituals, adoration of idols and stars, sport hooliganism etc.

This way we can follow the excellent performances produced by prototypes of sportsmen, more machines or cyborgs than ordinary human. The emotions are post-added by some symbols and rituals (they wear crosses, tattoos, they pray after a race and so on, sometimes to stress their personality and attract the attention). However,

not just sportsmen are exposed to this situation. The emotions of some sport fans, for example football hooligans in the extreme case, are often very strong. Their feelings (no matter how they can be authentic) are mostly compensative and diversionary. Not spiritual in a deeper sense of this meaning.

In this point some sports (especially so called spectator sports) can be typical representatives of the former which combine a positivistic approach and a diversionary function of pseudo-spirituality into one concept. As a typical example of this perception we can mention the aggressive behaviour of Slavia Praha football fans who demolished the team bus because of series of defeats in the Czech Gambrinus League in September 2013 (Sportovní noviny, 2013).

On the other hand, the spiritual approach which is based on the three components of secularized spirituality (there can be more of them found and described but even these three should be enough) could help to change the character of sport events (at least a bit) and to start searching for the basis of sport which is (beside the competition) a pure physical activity. The logical result of the spiritual approach is the support of active human movement and focus on the children and their physical education. A simplified structure of these ideas is displayed in the Fig. 2.

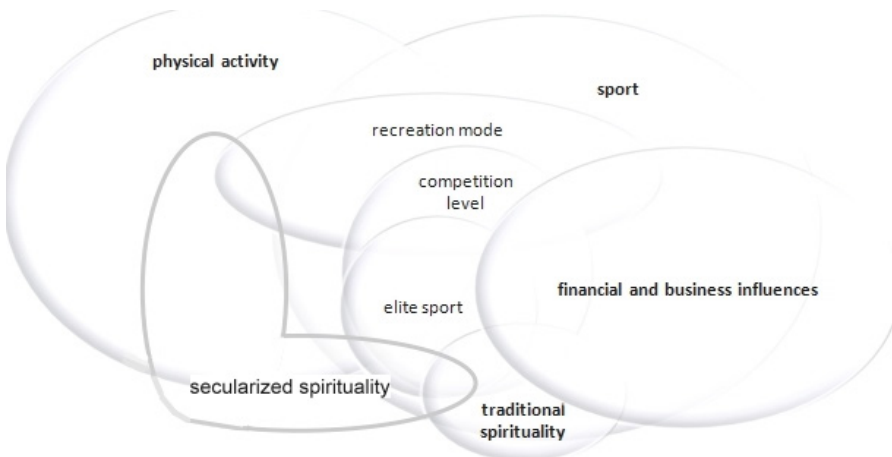


Fig. 2 Sport and spirituality

Discussion

The Czech Republic is a typical example of developing trends to secularity. Philosophers often speak about an existential vacuum. Religionists then speak about the loss of belief. However, the modern Euro-American society is full of humanity. Charity is the essential part of our everyday lives. There are a lot of social arrangements which support quite a high life standard of higher number of people than any in the past, no matter how it is different in various countries and areas. The economical crisis of the last years displayed how much the society is dependent on the positivistic definition of happiness (economic growth, gross national product etc.). There is a lot of space for populist approaches often based on the “clear solution” – increasing the size of the economic parameters. This leads to the focus on the exact data and reduces quality of life to this positivistic interpretation. This process has started to be more globalized since the beginning of the 21st century (Swank & Betz, 2002).

There is a big group of people in The Czech Republic who are (for historical reasons) very secular and it is not possible to expect they can accept religion, at least not in a short time. However, it is necessary to find a different kind of spirituality for this part of our society as a kind of prevention from the growing resignation on the ideals of humanity, from losing a system of values and underrating the virtues. That means those virtues which used to accompany our civilisation from its beginnings.

What are the advantages of this secularized spirituality presented in our model? There is no need of institutionalization here and no connections to the compulsory rituals. This spirituality is civic, non-ostentatious and intimate even if it is based on the interaction with the other person (appreciation of him and response to him). People in this country (Czech Republic) are hungry for the respect of their “inner space” which was many times in the past disturbed and violated. Mass media, politicians and economist often try to penetrate into this space. The church did it in the past as well and many people have got some relicts from their feelings in their historic memories.

In The Czech Republic sport presented for many years (at least from 1940s to 1980s) something like a shop window of building socialism successes. It was understood as a possibility how to reach some hardly achievable aims – to earn extraordinary money, to travel over the world, to overcome the grayness of the average. This is not anything reprehensible itself but the problem appears when the aims are determined only by these viewpoints. Since 1989 the conditions in The Czech Republic changed very rapidly but the way of thinking has been changing much more slowly. The process which started secularization here was quite long and very effective (there were also completely different historical conditions than in Poland, for example) and that is why we should accept the rate of secularity of the Czech society as a fact. This (the fact

that religiosity is quite low here) could be taken as one more reason why we should search for spirituality in its pure form. Sport as a phenomenon needs some kind of renaissance very urgently.

Parry (2007, 208) speaks about religiosity in the context of the Olympic Movement and reminds sentiment, ceremony and symbols. It is true that some symbols are necessary for us if we want to keep the tradition and to help people feel the togetherness. Then it is very important if these symbols are not profaned. Only then they can be considered as credible. Some religious institutions and symbols became (for different reasons) profaned for quite a big part of the Czech society. The secularized spirituality brings a great opportunity to restore the *religio athletae* (ibid, 205) in a new and modern shape.

Conclusions

This paper tries to emphasise that a spiritual approach to sport is a good chance how to help with looking for a solution of some problems in the modern sport. Spirituality is also about coping – about finding life meanings that will carry us through all sorts of experiences, including those that challenge our faith and hope. And sport can be a part of this.

The author believes that the topic of the spirituality of movement activities will become a more frequent theme of the serious studies in kinanthropology. Via this we can try to search for a deeper sense and a more versatile perception of movement activities at all.

References

- Dhokrat, G. K. (2012). Commercialization in sports and situational ethics: A sport-persons perspective. *Applied Research And Development Institute Journal* 5 (6), 40-43.
- Hurych, E. et al. (2013). *Spiritualita pohybových aktivit*. Brno: Masarykova univerzita.
- Jirásek, I. (2013). *Spiritualita pohybových aktivit: Vymezení diskursivního přístupu*. In E. Hurych et al. (Ed.). *Spiritualita pohybových aktivit* (pp. 8-16). Brno: Masarykova univerzita.
- Joslin, R. (2004). *Running the spiritual path: a runner's guide to breathing, meditating, and exploring the prayerful dimension of the sport*. New York, US: St. Martin's Griffin.
- Kahan, D. (2002). Religiosity as a determinant of physical activity: the case of Judaism. *Quest* 54, 97-115.
- Parry, J. et al. (2007). *Sport and Spirituality. An introduction*. London, UK: Routhledge.
- Preece, G. & Hess, R. (Eds.). (2006). In *Sport and spirituality: an exercise in everyday theology* [Interface: a forum for theology in the world, 11 (1)]. Adelaide, Australia: ATF Press.
- Robinson, S. & Parry, J. (2013). *Spiritualita: K otázce definice*. In E. Hurych et al. (Ed.). *Spiritualita pohybových aktivit* (pp. 17-28). Brno: Masarykova univerzita.
- Saint Sing, S. (2004). *Spirituality of sport: balancing body and soul*. Cincinnati: St. Anthony Messenger Press.
- Swank, D. & Betz, H. G. (2002). Globalization, the welfare state and right-wing populism in Western Europe. *Socio-Economic Review*, 1 (2), 215-245.
- Sportovní noviny 2013 [online]. *Fotbalisty Slavie po návratu z Jablonce napadli chuligáni*. [Quoted 26. 9. 2013]. Retrieved from <http://www.sportovninoviny.cz/zpravy/fotbalisty-slavie-po-navratu-z-jablonce-napadli-chuligani/987047>.
- Štampach, I. O. (2010). *Na nových stezkách ducha: přehled a analýza současné religiozity*. Praha: Vyšehrad.

Štampach, I. O. (2013) [online]. Odmítám dělit lidi na věřící a nevěřící. Žurnál UP. [Quoted 26. 9. 2013]. Retrieved from <http://www.zurnal.upol.cz/cmtf/zprava/clanek/stampach-odmitam-delit-lidi-na-verici-a-neverici>.

Zinnbauer, B. J. et al. (1997). Religion and spirituality: unfuzzifying the fuzzy. Journal for the Scientific Study of Religion, 36 (4), 549-564. Retrieved from: <http://www.zurnal.upol.cz/cmtf/zprava/clanek/stampach-odmitam-delit-lidi-na-verici-a-neverici/>

Physical Activities in Czech Society

Aleš Sekot

Faculty of Sport Studies, Masaryk University, Brno, Czech Republic

Abstract

Physical activity of people plays increasingly important position in scientific research. In our cultural setting regular physical activity plays only marginal role in everyday activities in most professions, households as well in transportation. Active way in general is more and more related to healthy quality life style. Medical science accents physical activity and proper eating habits as an indispensable part of good physical and physical shape and wellness.

Contemporary sedentary life style is the result of a socialization process towards physical inactivity developed in youth and continued into adulthood. At the present we face in our cultural settings apparent tendency: People losing beneficial impacts of community activities, involved in passive way of life lacking proper level of physical activities and active sport. Some preliminary data of the time of being in progress research of physical activity of Czech population are presented to describe specific relation of sport and sedentary society. At the same time the Czech Republic is strongly influenced with the existence of new development of the city structure, including fitness centres, cyclo paths, roller skates stadiums, beach volleyball playing fields, golf courses. General conclusions of the paper are concentrated on the question what Czech society expects from sport in given context of existing tendencies in mutual relation of sport and society.

Keywords: *Physical activity, sport, obesity, society, socialization, built environment, nutrition.*

Introduction

We are living a time when society, culture and science have become increasingly aware of the great importance of sport not only as a part of mass culture, but broadly understood, for individual and social health and well-being (McElroy, 2002; Rzewnicki, 2003.). The transformation from industrial to an information society since the 1960st and big advances in computer technology cause “the great wave of change“. Significant changes in the composition of the workforce transferred the economic and the social roles of men and women, but also affected matters of health, attitudes to physical activities and sport (Drucker, 1993; McElroy, 2002; Telama,

2007). As a result of political and economic changes which occurred in the Czech Republic two decades ago, all areas of society started to be *restructured*. Naturally, this process also included public administration having responsibilities for many areas of the people's lives, including sport. This new way of "public matters provision" started at the beginning of the 1990s and culminated in the period of 2000-2002.

In general, the approaches of municipalities in the Czech Republic to sport show many differences. The causes of the identified *differences* and, in particular, of a totally different approach to policy making, therefore, must be sought elsewhere. In the different approaches to sport the political bias of elected and decision-making bodies of the municipality is reflected as well the degree of personal enthusiasm for sport of the persons who have decision-making authorities in the municipality. It is evident that in municipalities differing by their geographical position and appearance, the number of inhabitants and their socio-economic characteristics and economic development: But the evident is: The sport policy making is not yet a common standard. (Slepičková and Staněk, 2007).

To summarize situation of *sport versus local authorities* in the Czech Republic the *financial limitations and political priorities* play very important role, as well as professional competence and personal preferences of particular councillors. The approach of the individual town areas to sport is very different and there are often original public policies in this field. A very diverse approach is also seen in the field of maintenance and development of the sports infrastructure and its utilization. In almost all of parts of the Czech Republic, the great importance is on renovation of school facilities. However, the access of the general public to the sport facilities often collides with the clearly commercial use of the facilities (Staněk and Flemr, 2007, 294-297).

Materials and methods

To discuss crucial topic "Physical activities in the Czech sociological perspective" means to present some relevant research data on physical and sportive activities of Czech population. At this context we also have to remind the fact, that the existing *whirlwind of changes* associated with way of life and standard of living regarding working activities, nutrition, housing, environment, transport, leisure, travelling etc. have with no doubt strong impact at a physically active lifestyle.

We live in the cultural setting adoring youth, beauty, healthy and sexy body and physical performance. Unfortunately, images of fit and healthy attractive personalities and widely circulated health messages have not translated effectively into increased physical activity for most Czech people. Findings from number of large- scale surveys

point to the aversion or the inability of most Czech people to participate in regular amounts of physical activity. Sportive activities are more less rather the manifestation of „up to date“ style of life, then as an integral part of everyday life. It is for more and more financially prospering people in good social position the expression of the prosperity and the ability to freely spend and choose independently their leisure.

People prefer, in general, *passive form of leisure*, watching sport rather than doing sport. Overweight adults being deficient in good physical condition are putting themselves at risk for disease and disability. Medical expert predicted properly that the *declines in physical activity* the current generation of Czech children will grow into the most obese generation of adults in Czech history: The sedentary living beset contemporary Czech society, as identically U.S. and plenty of European societies too. In such situation we are more and more confronted with pressing questions: „Why do people who know they should be more physically active still fail do so? What form the obstacles to achieving a more physically active lifestyle? And very pragmatic question is brought up to date: Is it in sedentary postmodern virtually oriented life possible to transform contemporary people into a more physical active society? What is the real prospect of our endeavour to create a social structure more conducive to a healthier society? Is it possible to overcome persistently questioned limitations found in many of the traditional approaches to promoting physical activity? Are we able to work effectively on the way of innovative strategy to increase physical activity at home, at school, and within the community (Sekot, 2008)?

Results

Besides some partial surveys of leisure activities of young generation exists some representative researches of a position of sport and sportive activities of Czech population. One of the very representative researches with random sample of 952 respondents older 18 years of age organized Charles University in Prague. Research confirmed very high level of prestige of sport and sportive activities in Czech society (Slepička and Slepičková, 2002). But at the same time was confirmed generally known fact that the significant part of population its positive attitude to physical activities does not realize in practical personal everyday life in the form of *regular sport activities*. Only one third of respondents declared regular sportive activity at least one time during a week, irregularly and by chance is involved in sport one fifth of respondents. Seventy percent of Czech people is not associated in sport organizations. On the decline is also positive opinion accenting an importance of mass sportive activity. Presented research has not been interested only in an opinion of Czech population on the role of sport for contemporary people, but was also searching for existing interests in alternative sports,

prevailing barriers of active sporting, accessibility to sport facilities, level of passive and active interests regarding sport. Fundamental topic, general importance of sport and physical activities for Czech population is in mentioned research reflected in answer reflecting very high level of positive importance of sport for individuals and the society. The highest importance is connected with positive contribution of sportive activities for the health, fitness, well-being, social prestige. Such attitude reflects also high value acknowledgement and a credit of health for all generations of population. At the same time the impact of sport as an indispensable factor of socialization is growing, notably as a form of meaningful way of leisure. The results reflect also existing discrepancy between positive attitudes to sport and the conviction to be *more intensively* involved in active sport (Slepička and Slepičková, 2002, p.15): Presented structure of attitudes to sport activities reflects given social and cultural situation in Czech post-reformation setting: People are not consistent enough to overcome their laziness, are too much busy, too much involved in everyday economic problems, not properly appreciated and enjoying refreshing impact of regular physical activities compensating many-sided stress of societal life. But we also take into account the fact, that people are prone to declare an absence of leisure as substitutional reason. Regarding future role of sport respondents declared prevailing widely sceptical opinions reflecting existing process of growing disparity between top elite professional sport and mass recreational sport. Such process also supports *consumerist nature of contemporary sport* in general. Most frequent reason for sportive activities of men is building up physical condition, body shape and societal prestige. Women are more sceptical in reference to their chance practise recreational sport regularly: They complain of absence of leisure, financial potentials and organisational obstacles.

Relatively positive perception of physical condition of respondents is reflected in declaration of *frequency of sport activities*: One third of respondents declare active sport activities at least once a week (37 % of men, 29 % of women). Women are doing sport activities less regular in relation to men. Women are also more frequently absolutely physically inactive then men.

Presented data reflect in Czech population growing tendency of passive attitudes to sport. Physical inactivity is justified with absence of leisure, absence of meaningful motivation and an existence of healthy problems. 40 % of „programmatically physically inactive“ acknowledge substantial aversion to physical activity, 28,5 % declare healthy problem and 20 % absence of leisure. Only marginally is declared absence of sport facilities and financial obstacles (Slepička and Slepičková, 2002, p. 19-21).

Relevant *recommendations* regarding physical activities in Czech context are accenting the need to prepare and to realize self-contained programs for active recreational sport for all groups of population and within school teaching of physical

education contribute to long-life interest in active physical activities (Frömel and Bauman et al., 2006, p. 21). In addition it is necessary to mention that 2 hours of physical education per week for pupils and students is not resolutely enough. Also young people are recommended for active participation in tourism, recreation and sport, as the foundation of physical culture. Physical education in its humanistic version is understood as „an education of man for the care of the body”.

The research organized by Masaryk university, Brno ”Physical activity in the perspective of physical activity of Czech inhabitants” being now in progress in the perspective of preliminary research data on sportive and physical activity in context of fundamental demographic indicators: sex, age, education, nature of occupation, domicile. Character of occupation of 1 117 respondents (505 men, 612 women) is as follows:

Tab. 1 Character of occupation/study

	sex	Physical	Sedentary	Physical and sedentary	No work
sex	men	13.66 %	41.39 %	33.47 %	11.49 %
	women	9.16 %	35.78 %	33.82 %	21.24 %
age	18 - 29	11.59 %	39.02 %	38.11 %	11.28 %
	30 - 39	12.64 %	45.98 %	34.10 %	7.28 %
	40 - 49	10.36 %	45.60 %	41.45 %	2.59 %
	50 - 59	12.93 %	42.86 %	38.10 %	6.12 %
	60 - 69	7.03 %	18.75 %	18.75 %	55.47 %
	70 - more	10.00 %	8.33 %	3.33 %	78.33 %
Men	18 - 29	15.34 %	36.81 %	38.04 %	9.82 %
	30 - 39	13.68 %	53.85 %	31.62 %	0.85 %
	40 - 49	15.73 %	42.70 %	38.20 %	3.37 %
	50 - 59	11.48 %	50.82 %	37.70 %	0.00 %
	60 - 69	9.62 %	28.85 %	25.00 %	36.54 %
	70 - more	8.70 %	8.70 %	0.00 %	82.61 %

Women	18 – 29	7.88 %	41.21 %	38.18 %	12.73 %
	30 - 39	11.81 %	39.58 %	36.11 %	12.50 %
	40 - 49	5.77 %	48.08 %	44.23 %	1.92 %
	50 - 59	13.95 %	37.21 %	38.37 %	10.47 %
	60 - 69	5.26 %	11.84 %	14.47 %	68.42 %
	70 - more	10.81 %	8.11 %	5.41 %	75.68 %
Total		11.19 %	38.32 %	33.66 %	16.83 %

It is evident that physical activity as an integral part of occupation is declining with sedentary character of professional work; there are not important differences between both sex groups: Sedentary occupations are more frequent in age group 50-59 for men and 40-49 for women.

Tab. 2 Intensive physical activity during last seven days

		No activity	Less than 1 hour	1-3 hours	3-6 hours	More than 6 hours
sex	men	7.33 %	19.21 %	34.85 %	18.81 %	19.60 %
	women	9.64 %	28.27 %	35.46 %	14.87 %	11.44 %
age	18 - 29	6.10 %	21.95 %	35.37 %	17.99 %	18.60 %
	30 - 39	8.43 %	24.52 %	34.10 %	18.77 %	14.18 %
	40 - 49	9.33 %	20.73 %	40.93 %	16.58 %	12.44 %
	50 - 59	5.44 %	25.17 %	37.41 %	14.97 %	17.01 %
	60 - 69	14.06 %	31.25 %	28.91 %	12.50 %	13.28 %
	70 - more	16.67 %	28.33 %	28.33 %	13.33 %	8.33 %
Education	No education	0.00 %	0.00 %	0.00 %	100.00 %	0.00 %
	Elementary	8.57 %	40.00 %	22.86 %	8.57 %	20.00 %
	Workmen	14.17 %	19.17 %	32.50 %	15.83 %	17.50 %
	High school	8.63 %	23.01 %	35.62 %	17.48 %	15.04 %
	University	7.10 %	25.44 %	36.49 %	16.57 %	14.40 %
Total		8.52 %	24.22 %	35.25 %	16.68 %	15.16 %

Men are more active in the field of physical activity than women, absence of physical activity during last seven days declare less than 10% of respondents, almost 20% of men are physically active more than six hours in last week. Absence

of physical activity decline in the course of senior age, most physically active are youngest respondents. Workmen are most physically active; high school and university educated are in this respect comparable; physical inactivity is typical for elementary educated respondents.

Tab. 3 Regular daily walking in hours

		No one	One hour	1-3 hours	3-6 hours	More than 6 hours
Sex	men	1.19 %	28.91 %	36.83 %	23.56 %	9.50 %
	women	0.65 %	18.14 %	41.83 %	24.84 %	14.38 %
age	18 - 29	0.30 %	19.82 %	42.99 %	24.70 %	12.20 %
	30 - 39	0.77 %	22.99 %	36.78 %	26.82 %	12.64 %
	40 - 49	1.55 %	25.39 %	39.90 %	22.80 %	10.36 %
	50 - 59	0.00 %	24.49 %	38.78 %	21.77 %	14.97 %
	60 - 69	1.56 %	21.88 %	35.16 %	28.13 %	13.28 %
	70 - more	3.33 %	31.67 %	43.33 %	13.33 %	6.67 %
Education	No education	0.00 %	100.00 %	0.00 %	0.00 %	0.00 %
	Elementary	2.86 %	25.71 %	31.43 %	22.86 %	17.14 %
	Workmen	0.00 %	21.67 %	30.00 %	26.67 %	21.67 %
	High school	1.55 %	21.68 %	40.04 %	23.67 %	13.05 %
	University	0.39 %	24.06 %	42.21 %	24.46 %	8.88 %
Total		0.90 %	22.96 %	39.64 %	24.30 %	12.20 %

Women are more active in walking than men, popularity of walking (as the most accessible way of natural physical activity) is growing with the course of the age. Almost 30% respondents of age group 60-69 are daily walking 3-6 hours per day; low popularity of daily walking as reflection of sedentary professional way of life (and individual automobile transport to work too) is typical for age 40-49. Walking is unpopular for young people and for respondents of lower educational status.

Particular data of presented research supported hypothesis on growing popularity of leisure physical activities of more educated people, high level of preference of walking in senior age groups and general tendency to sedentary occupations and professions.

Discussions

To discuss broader problems of position of physical activities in sedentary society means also remind phenomenon of active style of life and responsible attitude to personal individual health and physical shape. Underlying health determinants of a socioeconomic nature play a major role in causing vulnerability to health risks, including obesity. Indeed, a social gradient in obesity has been demonstrated with individuals in lower socioeconomic groups (lower incomes or lower levels of education, or both) having a higher risk of being obese and thus of suffering from obesity-related diseases. The reasons why these inequalities have arisen and persist include the constraints imposed by low income and educational achievement on food choices, opportunities for recreational exercise, and differential absorption of health promotion messages.

People prefer, in general, *passive form of leisure, watching sport* rather than doing sport. Overweight adults being deficient in good physical condition are putting themselves at risk for disease and disability.

Hlúbik et al, carried out an investigation on obesity in the Czech Republic in the year 2000. The study monitored 933 volunteers, both sexes and with an age ranges of 19-60 years. Anthropometric parameters such as weight, height, skin fold thickness and abdomen circumference were measured. BMI and fat tissue percentage were calculated on the basis of gathered data. The authors detected overweight in 67.5% of monitored men, obesity in 17.0% of them. 50.0% of women of were overweight while obesity was detected in 18.9% of them. Waist circumference exceeding 102 cm was measured in 41.2% of men and waist circumference exceeding 88 cm in 41.7% of monitored women. (Hlúbik, 2000).

Physical activity is a complex behaviour. Any activity can be described in terms such as intensity, frequency and duration, and these dimensions must be considered. An assessment methodology should also consider inactivity, such as time spent sitting. *Physical activity can be related to work, transportation, home and leisure time.* The activities at either of these domains may have specific health consequences, and advanced monitoring should also consider these. To present most important results of existing research data it is possible to conclude (Frömel and Bauman, 2006):

1. Growing age of population (men and women too) decreases number of week days and volume of time devoted to physical activity.
2. Men in general are more involved in physical activities comparing with women.
3. Growing age decreases existing differences in intensity of physical activity between men and women.

4. Medium level of physical activity and walking is distributed in age groups and gender groups relatively evenly.

5. Walking is most frequent form of physical activity in Czech population.

6. Regular monitoring of level and tendencies of physical activity of population is integral part of monitoring of health situation and life style of population.

The phenomenon of *obesity* in the context of physical activity is strongly connected with the area of teaching of physical education on given *level of school*. One of the most important role for acquiring proper habits and patterns regarding regular lifelong physical sportive activity play primary and secondary schools. Research sample of 153 11-15 years old Czech rural pupils exposed 20.0% overweighed boys and 9,6% overweighed girl and 2.9% obese boys and 1.2% obese girls. Contrariwise 14.3% boys and 21.7% girls were under commensurate weight (Rýgl 2006). Most respondents are interested in collective sportive activities (e. g. ski training, biking, boating). Most popular sportive game for 12 years old girls are ball game pig-in-the middle, rugby, floorball, volleyball and basketball. The same age boys prefer floorball, football, rugby, handball, basketball. Overall results refer to high level of popularity of physical education comprehended mostly as a explicitly attractive activity. Research in such context accents a necessity to improve attractive and emotively experienced aspects of physical education to improve high competence of kinetic physical activities for lifelong body and healthy care. At that time the importance of strict „marking“ of sportive performance is not recommended – more attention is concentrated for to support of individual ability to be regularly involved in physical/sportive activities. We believe that it is convenient step for to support popularity of regular all-round active leisure physical activities as an integral part of value orientation of young generation facing negative aspect of sedentary society.

Conclusions: *What Czech society expects from sport?*

Mutual relations of sport and society are mostly and visibly reflected in mediated television top sport events. In this context we face typical reflection of passive consumerism of sport as an important part of mass culture: people (society) expect from sport top performance, exciting show compensating monotonic course of everyday life. Society also found in top sport refreshing source of patriotism and medial celebrities, icons and heroes as a target of mass admiration in situation of their absence in the rest of society (mostly in politics). The existence of sedentary way of life detracts general level of physical/sport activities in everyday life of mass of people; growing importance of active way of life and human health improve phenomenon of individual

responsibility for human wellbeing. People responsible for his or her physical and psychological good shape expect from sport an indispensable source of wellbeing, respect of their surroundings, and – the last and not least – his or her self-respect.

High level of political will and leadership are required to achieve a decrease in obesity prevalence. All relevant state sectors and levels should play a role in support of sport as a form of *active way of life*: the new horizons for civil society are here outlined. In mass society just the media have an important responsibility in propagation and dissemination of health life-styles.

To discuss a phenomenon of physical activity means in such perspective to accent changing nature of lifestyles and leisure time activities that have adopted new forms, contents and meanings. The world of sport and physical activities is also changing all the time in numerous new sport disciplines and activities which are chosen by growing proportion of people. It could be expected that these changes would affect also the socialisation situations and environments of physical activity:

1. Presented structure of *attitudes to sport activities reflects* given social and cultural situation in Czech post-reformation setting: People are not consistent enough to overcome their laziness, are too much busy, too much involved in everyday economic problems, not properly appreciated and enjoying refreshing impact of regular physical activities compensating many-sided stress of societal life. But we also take into account the fact, that people are prone to declare an absence of leisure as substitutional reason. Relevant data reflects in Czech population *growing tendency of passive attitudes to sport*.

2. Physical inactivity is justified with absence of leisure, absence of meaningful motivation and an existence of healthy problems. 40% of “programmatically physically inactive” acknowledge substantial aversion to physical activity, 28.5% declare healthy problem and 20% an absence of leisure. Only marginally is declared absence of sport facilities and financial obstacles (Slepička and Slepičková, 2002).

3. To present most important results and information on tendencies in the field of physical activities means to conclude that *growing age of population* (men and women too) decreases number of week days and volume of time devoted to physical activity. Men in general are more involved in physical activities and active transport (cycling, walking) comparing with women.

4. Nowadays *physical education* is defined as the process aiming at preparation of children and young people for participation in physical culture (tourism, recreation, sport). It is also understood as the foundation of physical culture. Physical education in its humanistic version is understood as an education of man for the care of the body preparing children and young people for taking responsibility for health, fitness and the beauty of the body after competing education.

5. Phenomenon of physical/sportive activity is many-sided phenomenon connected with the concept of a *healthy life style*. Life style behaviours in general are significantly determined by social status, by professional position, by amounts of money and the quantity of property. Those who have the means may choose to be physically active; those lacking the financial resources cannot freely to choose to be involved in regular sportive activities. Unhealthy behaviours, including sedentary lifestyles, are influenced by people's position within social groups and broad social forces in the general society.

6. *Recommendations to sport organizations* for the systematic promotion of physical activities needs full support of local, regional and national public authorities:

1. To develop a membership strategy to include physically passive persons to sportive activities.

2. To specify the profile target of sport clubs with accordance to focus on elite and competitive sport or recreational leisure sport activities.

3. To improve coach and trainer standards of an inclusive social and pedagogical climate.

4. To accent natural outdoor activities as grass roots centres for mass involvement in physical activities.

5. To ensure and to enable high educational and pedagogical standards of voluntary and (semi) professional staff in sport clubs.

We can conclude: *Healthy lifestyles* are patterns of voluntary behaviours based on choices from options that are available to people according to their life situations. In developed post industrial countries the members of upper and middle class by way of active lifestyle mostly reflect their value self-identity accenting balanced share of an intellectual and a physical activities. It is a tendency to evaluate good health as a *personal value* to be sought and cultivated for one's own benefit, such as experiencing increased vitality and enjoyment of life. Lower-class individuals, with reference to the nature of their work activities and income, are less optimistic to avoid poor health and thus are less apt to participate in systematic health promoting activity. Anyway, members people in lower socioeconomic position experience poorer health and higher disease rates when compared with more privileged social groups.

7. Phenomenon of physical activity and sport is closely related to *urbanisation of sports facilities*. In such context it is useful to describe and analyse the most important milestones in the history of city-planning (urbanisation) in the area of sport facilities. The rapid housing and industrial development is resulting in numerous urban-architectural and moreover sociological issues. Sport facilities planning, creating, developing and

managing should be considered to be one of the strategic points in public (administration) on both the local and state level (Coakley, 2001, Flemr, 2007).

Even the preliminary results of presented research data and pilot studies imply that the individual municipal authorities in the pertinent town areas attach a diametrically *different importance to sport and sporting activities*. A large difference is already visible in the managing of sport and sporting activities within the organizational structures of the municipal authority. The most critical policy area on physical/sportive activity is the sole fact of *sedentary nature* of contemporary society: Very high level of prestige of sport and sportive activities in Czech society is incompatible with very low level of practical regular physical or sport activities.

References

- Drucker, P. (1993). *Postkapitalistická společnost*. Praha: Management Press.
- Formánková, S. (1998). Některé oblasti longitudinálního výzkumu zájmu žáků o pohybovou aktivitu. Celostátní vědecká konference s mezinárodní účastí v oboru kinantropologie. Olomouc: Hanex.
- Fořt, P. (2004) *Stop dětské obezitě*. Praha: Ikar.
- Fromel, K. et al. (2004). Physical activity of men and women 18 to 55 years of age in Czech Republic. In: F. Vaverka (ed). *Movement and Health*. pp. 169-173. Olomouc: Univerzita Palackého.
- Fromel, K. and Bauman, A. et al. (2006). Intenzita a objem pohybové aktivity 15-69leté populace České republiky. *Česká kinantropologie*. Vol. 10, č. 1, c. 13-27.
- Hlúbik, P. et al. (2000). Prevalence of obesity in selected subpopulations in the Czech Republic. *Sborník lékařský*, 1, s. 59-65.
- McElroy, M. (2002). *A Social Analysis of Inactivity*. Champaign, IL: Human Kinetics. Project no. 044291 (2008) „Prevention of Obesity in Europe – Consortium of the prevention of obesity through effective nutrition and physical activity actions – EURO-PREVOB.
- Rychtecký, A. (2007). *Active Lifestyles of Young People – Benefits and Outcomes. Obesity in Europe. Young People’s Physical Activity and Sedentary Lifestyles*. Berlin, Oxford: Peter Lang.
- Rýgl, P. (2006). Tvorba školních vzdělávacích programů pro oblast tělesné výchovy na základní škole. *Česká kinantropologie*, Vol. 10, no. 2, pp. 29-45.
- Říhová, M., Skálová, L. and Komárek, L., (2007). Health Behaviour of Young People. *School and Health* 21. p. 125-139. Brno: Masarykova univerzita a Paido.
- Rzewnicki, R. (2003). *Health Enhancing Physical activity. Measurement and determinant of daily activity at home, work, travel, and leisure*. Leuven: KU Leuven.

Sekot, A. (2006). Sociologie sportu. Brno: Masarykova univerzita a Paido.

Sekot, A. (2008). Physical Activity Versus Obesity. *Educatio Artis Gymnasticae*. vol.3, no. 3, p. 51-72.

Sekot, A. and Brázdová, Z. (2008). Physical Activity and Nutrition as a Social Factors Influencing the Epidemic of Obesity. *Studia Sportiva*, vol.2, no. 1, p. 112-125.

Sekot, A. (2010). Determinanty nadváhy a obezity: Pohybová aktivita a materiální prostředí, *Zdraví*, 1, pp. 24-32.

Slepička, P. and Slepičková, I. (2002). Sport z pohledu české společnosti. *Česká kinantropologie*, no. 1, pp. 7-23.

Slepičková, I. and Staněk, M. (2007). The impact of public administration reform on sport policy in Czech Republic. *Local Sport in Europe . 4th eass Conference Proceedings*.

Staněk, M. and Flemr, L. (2007). The role of local authorities of Czech cities in support of sport: A case study of the capital city of Prague. *Local Sport in Europe. EASS 4th Proceedings*.

Telama, R. Et al. (2007). Determinants and correlates of physical activity among European children and adolescents. *Obesity in Europa. Young People's Physical Activity and Sedentary Lifestyles*. Berlin, Oxford: Peter Lang). P. 265-279.

The Effect of Participating in Official Recreational Activities on Organizational Citizenship, Organizational and Professional Commitment, Life Satisfaction and Achievement Perception

Faik Ardahan

Recreation Department, Akdeniz University, Antalya, Turkey

Abstract

The purpose of the present study was to examine the effect of participating in official recreational activities on Organizational Commitment (OC) and Professional Commitment (PC), Organizational Citizenship Behavior (OCB), Life Satisfaction (LS), and Achievement Perception (AP) on the example of Antalya Governmental Hospital. To test the effect of recreational activities on OCB, OC, PC, LS, and AP in Antalya Governmental Hospital, the social committee organized some recreational activities according to the preferences of the employees. Trekking, Pilates, Folk dance, Music and Theatre were the most wanted activities. All these activities were done between September 2012 and March 2013.

As a result of this study, there are statistically meaningful and positive changes on the level of participants' OCB, OC, PC, AP, and LS. Participating in official recreational activities increases the level of OCB, OC, PC, AP, and LS of employees.

Keywords: *Organizational Citizenship, Organizational and Professional Commitment, Life Satisfaction, Achievement, Recreation.*

Introduction

In the last four decades, the reasons for participating in recreational activities have drawn attentions of scientists and business owners. The demand, the supply for leisure activities and the revenue of this sector have been growing rapidly (Kalkan, 2012). There are many reasons for doing, joining or demanding recreational activities (whether official or not, whether free of charge or not, whether indoor or outdoor, whether alone or with a group, whether casual or serious leisure...) (Burnett 1994; Cordes and Ibrahim, 2003; Ardahan, 2011) and many benefits of participating in recreational activities. These can be ordered as; feeling relaxed and refreshed, learning group dynamics, feeling more important, making friends and socialization, meeting new people, belonging to a group and a team, learning and improving skills, getting self confidence, making individual decisions, improving problem solving and decision making style, learning risk management, taking responsibility of self and others, helping others, spending time with friends and with family, getting environmental consciousness, improving and

getting physical and mental fitness, feeling happier, healthier and powerful, feeling the nature and neighborhood deeply, feeling ready for new challenges, improve personal borders, and being generous to diversity and a fault, improving intrinsic motivation, extending extrinsic motivation and decreasing amotivation situation (Burnett 1994; Weissinger and Bandalos 1995; Cordes and Ibrahim, 2003; Ardahan 2011). To perceive these benefits of recreation, some organizations accept organizing “official recreation” as a component or part of the business design to establish expected or predicted benefits like togetherness, closeness on its employees whether from outsourcing or employing expert’s for the recreation service or enlist an employer’s cooperation to improve and strengthen their leadership, problem solving and decision making capacity, organizational commitment, inter personnel or organizational communication and corporate governance, belonging to organization (Cordes and Ibrahim 2003; Karaküçük 2005; Ardahan and Ipeker 2013). These activities are mostly done in a business which runs total quality management process as a component of business design by a “quality circle team activity” (Kavrakoğlu, 1999). From this perspective, recreational activity is not a goal, but it is an instrument or a way to establish and improve expected and predicted behaviors by using different experience. Participating in recreational activities has positive affect on individual’s level of LS and job satisfaction (Cordes and Ibrahim 2003; Ardahan and Ipeker 2013).

LS can be defined as “the global judgment of a person’s life” or “individual’s emotional acts out of life and as a general attitude towards life” or “the realization level of expectations” (Diener 1984; Diener et al. 1985; Ardahan 2011). The factors affect LS can be ordered as finding life meaningful, having positive personality, having close friends, pleasure taken from daily life, reaching goals, quality of life, occupation and career, economic security, confidence in physical health, mental and physical wellness, positive relationships with family, colleagues and others, and so on (Augusto et al. 2006; Ardahan 2011; Bruce et al. 1976; Ngai 2005).

Achievement can be defined as reaching and/or realizing goals by using all resources efficiently and productively and has common meaning for individuals, organizations, societies and states. Definition also includes all the relation in work life, sport, cultural life, mental and physical healthy, family and social life (Ardahan and Ipeker, 2013). Furthermore, achievement is a need and conscious drive which can be explained by intrinsic and extrinsic motivation (McClelland, 1985). In another word, in the achievement searching, positive growths, reaching and realizing the goals affect individual’s LS, PC and OC. At the same time, individual who has high LS level has high achievement perception, too (McClelland, 1985). One of the basic requirements in organizations for realizing achievement is to establish and improve the level of the OCB, PC and OC perceptions of employees.

OC can be defined as the employee's willingness to have a strong desire and acceptance to stay with the organization's values and its major goals, to use high levels physical and mental effort support organizational goals and to use high levels effort on behalf of the organization (Porter and Lawler 1968). It involves feelings toward to the organization which they are employed and/or the degree of how much they were identified with the organization. OC has three sub dimensions as Allen and Mayer (1990) defined; the employee's emotional commitment to organization, continuance commitment to organization and normative commitment to organization (Meyer and Allen, 1984; Allen and Mayer 1990; Meyer et al. 1993; Mowday, 1998).

For many individuals, it is accepted that the work is vitally important in their life. Career is one of the important links between individual and society (Hall, 1975). Meyer et al. (1993) classified PC in three sub dimensions, the employee's emotional commitment to profession, continuance commitment to profession and normative commitment to organization profession.

OCB which was defined first by Bateman and Organ (1983) which interrogated by researchers who are interested in management, organization and/or business sciences draw inspiration from communal and forensic citizenship. Organ (1988) defined OCB as the total arbitrary behaviors of volunteered workers which are out of in role behaviors which are not considered directly and/or totally in formal reward and punishment system but to promote and motive the employees to facilitate effective functioning of the organization. Turnipseed (2002) defined OCB as a behavior beyond to get off punishments or to get rewards which were defined in employment contract. While punishment and reward were system defined in employment contract, OCB is called as pro-social behaviors, the total behaviors which were done by voluntarily and intrinsic motivation to realize organizational goals (George and Brief, 1992). In addition to this, OCB is defined as "good soldier" who helps others voluntarily, open innovation, has pro-social behaviors, away unnecessary conflict and arguing, complete all tasks on time by Smith, Organ and Near (1983), Turnipseed (2002), Bateman and Organ (1983).

The correlation between OCB and job satisfaction was firstly concluded by Organ (1988) and he found out that this correlation was very strong. For that reason, OCB and job satisfaction has meaningful effect on LS and AP. There are many internal and external factors which effect individual's job satisfaction and LS. Besides this there is a strong and linear relation between job satisfaction and LS (Bamundo and Kopelman 1980; Chacko 1983; Wilensky 1960). In addition to this, Blackhurst et al. (1988a, 1988b) concluded that PC has positive effect on LS, it makes LS increased. Besides this, London et al. (1977) found out that there was a positive correlation between job satisfaction and participating in recreational activities. Groves (1981) defined that participating official recreation increases job satisfaction.

As Cordes and Ibrahim (2003), Karaküçük (2005), Ardahan and Ipeker (2013) declared that in the last three decades, many medium or big size business/organizations in private, public and/or non governmental sector prefer the educational (in-service training) programs by using or including recreational activities especially outdoor recreation, and the demand for this kind of training program is increasing. Recreational education programs also increase personal motivation toward the organization, the work and it establish and repair the organizational communication.

As explained above, there are many factors affect individuals LS, OCB, OC, PC and AP. LS can be affected by organizational and the others factors, but OCB, OC, AP and PC just affected by majority organizational factors like “general economic and political structure of the government hospital management”, “salary and payment systems”, “persons’ expectation from management”, “organizational motivation factors”, “working hours and conditions”, “official motivational factors”, “managers and their leadership attitudes and behaviors”, “organization design”, “terms of reference”, and “personnel structure and size”. Because of these organizational factors were not changed, control group was not strongly necessary and so it was not allocated in this study. So the changes represent the importance of participating in official recreational activities and the importance of this study.

Methods

The Aim of this study was to examine the effect of participating in official recreational activities on OC and PC, OCB, LS and AP on the example of Antalya Governmental Hospital. This research is restricted by the participants in Antalya Government Hospital. The Sampling group of this study consists of 45 employees who had participated in official recreational activities between the dates September 2012/May 2013. All participants joined to outdoor activities, some of the participants joined to plates, dance, music and theatre activities. To find out the values of variables, at the end of March-2013, it was asked to all participants (n=45) “how you felt at the beginning of the September-2012 and what do you think know?” in the same questionnaire form for all scales and % 93 of the participants (n=42) answered clearly. The questionnaire form contains demographical questions and OC and PC scale which was developed by Meyer et al. (1993), OCB Scale which was developed by Podsakoff et al. (1990), LS Scale which was developed by Diener et al. (1985) and Achievement Scale which was developed by Bilgin and Kaynak (2008). Since, in the process of assessing data the descriptive statistic methods, correlation test and t test have been used and results have been assessed according to significant level 0.05 and 0.01. A five-point Likert scale was used and the range covers (1: definitely disagree, 5: definitely agree).

Findings

Demographic information of participants was given in Table 1. As it seen Table 1, majority of participants is female, has monthly income about 1200 € or below, married, has university degree or higher education level, working as nurse or health officer. They have all preferred trekking activities, and their mean age was about $\bar{X}=38.45\pm5.347$ and length of employment of participants in this hospital is about $\bar{X}_{\text{year}}=13.60\pm6.398$ and their employment time in this occupation is about $\bar{X}_{\text{year}}=17.64\pm6.132$.

The statistical comparisons of LS, AP, OC, PC and OCB and the correlation of LS and AP with PC, OC and OVB were given in Table 2. There is statistically meaningful difference between before and after level of participant's LS, AP, PC, OC, OCB level. Participating official recreational activities increase the level of participant's LS, AP, PC, OC and OCB. It was found statistically meaningful correlations between LS and AP, OC, PC, OCB and AP and OC, PC, OCB before and after participating official recreational activities.

Tab. 1 Demographics Information of Participants

Gender	n	%	Marital Status	n	%
Male	6	14.3	Married	33	78.6
Female	36	85.7	Single	9	21.4
Income (monthly)	n	%	Education Level	n	%
800 € and below	5	11.9	High school and below	1	2.4
801-1200 €	29	69.0	University and high	41	97.6
1201-1600 €	2	4.8	Occupation	n	%
1601-2000 €	2	4.8	Doctor	2	4.8
2001 € and high	4	9.5	Nurse/Healthy Officer	36	85.7
Recreational Activities	n	%	Civil servant and others	4	9.5
Trekking	42	100.0	Total	42	100.0
Plates	6	14.3	Some means of Demographics	Mean	St. Dev.
Turkish Folk Dance	10	23.8	Age	38.45	5.347
Music	3	7.1	Length of employment in this hospital	13.60	6.398
Theatre	1	2.4	Employment time in this occupation	17.64	6.132
Total	42	100.0			

Tab. 2 The comparison of OCB, LS, AP, OC and PC in the beginning and the end of Recreational Activities and the correlation of AP, OC and OCB with LS and AP

Gender	n	%	Marital Status	n	%
Male	6	14.3	Married	33	78.6
Female	36	85.7	Single	9	21.4
Income (monthly)	n	%	Education Level	n	%
800 € and below	5	11.9	High school and below	1	2.4
801-1200 €	29	69.0	University and high	41	97.6
1201-1600 €	2	4.8	Occupation	n	%
1601-2000 €	2	4.8	Doctor	2	4.8
2001 € and high	4	9.5	Nurse/Healthy Officer	36	85.7
Recreational Activities	n	%	Civil servant and others	4	9.5
Trekking	42	100.0	Total	42	100.0
Plates	6	14.3	Some means of Demographics	Mean	St. Dev.
Turkish Folk Dance	10	23.8	Age	38.45	5.347
Music	3	7.1	Length of employment in this hospital	13.60	6.398
Theatre	1	2.4	Employment time in this occupation	17.64	6.132
Total	42	100.0			

* $p < 0.05$, ** $p < 0.01$

Conclusion

It was found in many studies that participating in recreational activities (whether official or not, whether free of charge or not) has positive effect on participants physical and mental health, well-being, social relations, job life and LS (Ardahan, 2011; Baker and Palmer, 2006; Cordes and Ibrahim, 2003; Kalkan, 2012; Rodriguez et al. 2008). The conclusions of these studies support the current study's results. In another word, it can be stated that participating official recreational activities increased the person's LS, physical and mental healthy level. Furthermore, participants feel themselves refreshed, rest, ready to hard work, make themselves more fighter, goal-focused, make willing to take other's and social responsibilities, increase their problem solving capacity and empathy capacity (Ardahan, 2011; Cordes and Ibrahim, 2003; Kalkan, 2012). Participating in official recreational activities have positive effects on participant's AP. It can be concluded that increased AP level will have positive effect on participant's family and social life and increase AP level in their job life (Ardahan and Ipeker, 2013; Cordes and Ibrahim, 2003). These conclusions overlap the current study's results.

It was found that as AP increases, OCP increase, too. In another word, when achievement level of a person expands, LS and OCB of a person expand depending on AP. In addition to these, there are statistically meaningful positive correlation

between AP and the other four sub factors of OCB, except sportsmanship. It was not found any study on recreation, organization, or management which examines the relation between participating in any recreational activities and OCB or the effect of participating in any recreational activities on OCB.

Bateman and Organ (1983), Williams and Andersen (1991), Schappe (1998), Feather and Rauter (2004) concluded that “to achieve a goal which is defined by self or others”, “to present and bring oneself into notice”, “to fight with trouble”, “to put good show”, “to be ready and volunteer to try to cope with a situation or physical, psychological and mental difficulties and barriers”, “to do and focus on all these goals without any prize expectation”, “to be volunteer to take responsibility, profession and job dedication” have positive effect on OCB ad job satisfaction. This conclusion overlaps with the results of current study.

In many researches, it was concluded that, if a person’s PC, OC and LS increases, depending on these changes, productivity of that person increases, too (Allen and Meyer, 1990; Meyer and Allen, 1984). In another word, when employees feel themselves more productive and efficiency, they will be more successful than before. This conclusion overlaps with the statistical positive correlation between AP and PC and OC found in current study. Furthermore, participating in official recreational activities has positive effect on AP. It can be concluded that when a person’s AP level increases PC and OC of this person will increase, too.

Bateman and Organ (1983), Williams and Andersen (1991), Schappe (1998), Feather and Rauter (2004) concluded that “the perseverance to achieve a goal which is defined by self or others”, “the desire to fight with trouble”, “to put good show”, “to present and bring oneself into notice”, “to be ready and volunteer to try to cope with a situation or physical, psychological and mental difficulties and barriers”, “to do and focus on all these goals without any prize expectation” have positive affect on PC, OC and AP of a person. In addition to these conclusions, other results of some studies as; the high PC and OC will cause high LS (Blackhurst et al. 1988a, 1988b), participating in official recreation increases employees job satisfaction and LS (Groves, 1981). All these conclusions can be considered together to explain the positive correlation between AP and PC, OC, LS in the current study.

As a result of this study, it can be stated that participating in official recreational activities which were used as an instrument and were organized by an organization (whether free of charge or not) have statistically positive effect on participant’s AP, PC, OC, LS and OCB. For that reason, for organizations in private sector, public sector and/ or non governmental sector, organizing official recreational activities (whether free of charge or not) which an employee can participate with his family members and/ or social friends will effect positively and increase the emotional link and commitment between

employee and organization, between employee and profession, between employee and colleague, will strengthen the poor or negative communication and governance in the organization, and also will increase the employee's willingness and readiness to join and to support organizational process.

References

Allen, N. J. and Meyer, J. P. (1990). The measurement and antecedents of affective, continuance, and normative commitment to the organization, *Journal of Occupational Psychology*, 63(1): 252-276.

Ardahan, F. (2011). The profile of the Turkish mountaineers and rock climbers: the reasons and the carried benefits for attending outdoor sports and life satisfaction level. In 8th International Conference Sport and Quality of Life/2011, 10-11 Nov 2011, Congress Centre-Brno/Czech Republic.

Ardahan, F. and Ipeker, T. (2013). The Effect of Participating in Official Recreational Activities on Organizational Citizenship Behavior, Life Satisfaction and Motivation for Achievement: the case of Antalya Governmental Hospital, The 21st Conference of the European Association for Sport Management Turkish Pre-Conference and International Congress on Sport and Management, 11-15 September 2013, Istanbul.

Augusto, J. M., López-Zafra, L. E., Martínez de Antoñana, R. and Pulido, M. (2006). Perceived emotional intelligence and life satisfaction among university teachers. *Psicothema*, 18, 152-157.

Baker, D. A. and Palmer, R. J. (2006). Examining the effects of perceptions of community and recreation participation on quality of life. *Social Indicators Research*, 75: 395-418.

Bamundo, P. J. and Kopelman, R. E. (1980). The moderating effects of occupation, age and urbanization on the relationship between job satisfaction and life satisfaction. *Journal of Vocational Behaviour*, 17(1): 106-123.

Bateman, T. S. and Organ, D. W. (1983). Job Satisfaction and The Good Soldier: The Relationship Between Affect and Employee Citizenship, *Academy of Management Journal*, 26(4): 587-595.

Bruce, A. C., Stan, L. A., and Phillip, R. K. (1976). Marital and family role satisfaction. *Journal of Marriage and Family*, 38(3), 431-440.

Burnett, D. (1994). Exercising better management skills. *Personnel Management*, 26(1): 42-46.

Bilgin, N. and Kaynak, R. (2008). Sosyal Sermaye Faktörlerinin İş Başarısına Etkisi: Üniversite Çalışanları Üzerine Ampirik Bir Çalışma, *C.Ü. Sosyal Bilimler Dergisi*, Mayıs 2008, 32(1): 29-38.

Blackhurst, A. E., Brandt, J. E. and Kalinowski, J. (1988a). Effects of Career Development on the Organizational Commitment and Life Satisfaction of Women Student Affairs Administrators, *NASPA Journal*, 36: 19-34.

Blackhurst, A. E., Brandt, J. E. and Kalinowski, J. (1988b). Effects of Personal and Work-Related Attributes on the Organizational Commitment and Life Satisfaction of Women Student Affairs Administrators, *NASPA Journal*, 35: 86-99.

Chacko, T. I. (1983). Job and life satisfactions: as causal analysis of their relationships. *Academy of Management Journal*, 26(1): 163-169.

Cordes K. A. and Ibrahim H. M. (2003). *Applications in Recreation and Leisure for Today and Future Third Edition*, Von Hoffmann Press, New York.

Diener, E. (1984). Subjective well-being. *Psychological Bulletin*, 95(3): 542-575.

Diener, E., Emmons, R. A., Larsen, R. J. and Griffin, S. (1985). The Satisfaction with Life Scale, *Journal of Personality Assessment*, 49: 71-75.

Feather, N. T. and Rauter, K. A. (2004). Organizational citizenship behaviours in relation to job status, job insecurity, organizational commitment and identification, job satisfaction and work values, *Journal of Occupational and Organizational Psychology*, 77: 81-94.

George, J. R. and Brief, A. (1992). Feeling Good: A Conceptual Analysis of The Mood at Work or Organizational Spontaneity Relationship, *Psychological Bulletin*, 112 (2): 310-329.

Groves, D. L. (1981). Impact of Industrial Recreation Upon Job Satisfaction and Productivity, *Journal of Environmental Systems* 11: 187-200.

Hall, R. H. (1975). *Occupations and the Social Structure*, Englewood Cliffs: Prentice-Hall.

Kalkan, A. (2012). *Outdoor Recreation, Reasons For Individuals Participation In Nature-Based Sports Whit in The Province Of Antalya*, Akdeniz University, Social Sciences Institute, Sport Management Department, Master Thesis.

Karaküçük, S. (2005). *Rekreasyon Boş Zamanları Değerlendirme*. Gazi Yayınevi, Ankara.

Kavrakoğlu, İ. (1999). *Toplam Kalite Yönetimi*, Kalder Yayınları Rekabetçi Yönetim Dizisi No: 3, Ağustos, İstanbul.

London, M., Crandall, R. and Seals, G. W. (1977). The contribution of job and leisure satisfaction to quality of life. *Journal of Applied Psychology*, Vol 62(3):328-334. doi: 10.1037/0021-9010.62.3.328.

McClelland, D. C. (1985). *Human motivation*, Glenview, IL: Scott, Foresman.

Meyer, J. P. and Allen, N. J. (1984), Testing The Side-Bet Theory of Organizational Commitment: Some Methodological Considerations, *Journal of Applied Psychology*, 69(3): 372-378.

Meyer, J. P., Allen, N. J. and Smith, C. A. (1993). Commitment to Organizations and Occupations: Extension and Test of A Three-Component Conceptualization, *Journal of Applied Psychology*, 78(4): 538-551.

Mowday, R. T. (1998). Reflections on The Study and Relevance of Organizational Commitment, *Human Resource Management Review*, 8(4): 387-401.

Ngai, V. T. (2005). Leisure satisfaction and quality of life in Macao, China. *Leisure Studies*, 24(2), 195-207.

Organ, D. W. (1988). *Organizational Citizenship Behavior: The Good Soldier Syndrome*. Lexington MA, Lexington Book.

Podsakoff, P. M., MacKenzie, S. B., Paine, J. B. and Bachrach, D. G. (2000). Organizational Citizenship Behaviors: A Critical Review of the Theoretical and Empirical Literature and Suggestions for Future Research, *Journal of Management*, 26(3): 513-563.

Porter, L. W. and Lawler, E. E. (1968). What job attitudes can tell us about employee motivation. *Harvard Business Review*, 46, 118-126.

Rodriguez, A., Latkova, P. and Sun, Y. Y. (2008). The relationship between leisure and life satisfaction: application of activity and need theory, *Social Indicators Research*, 86: 163-175.

Schappe, S. P. (1998). The Influence of Job Satisfaction, Organizational Commitment, and Fairness Perceptions on Organizational Citizenship Behavior, *The Journal of Psychology: Interdisciplinary and Applied*, 132(3): 277-290, DOI: 10.1080/00223989809599167.

Smith C. A., Organ D. W. and Near J. P. (1983). Organizational citizenship behavior: its nature and antecedents. *Journal of Applied Psychology*, 68(4): 655-663.

Turnipseed, D. L. (2002). Are good soldiers good? Exploring the Link Between Organization Citizenship Behavior and Personal Ethics, *Journal of Business Research*, 55(1): 1-15.

Wilensky, H. L. (1960). Work, careers and social Integration. *International Social Science Journal*, 12(4): 543-560.

Williams, L. J. and Anderson S. E. (1991). Job Satisfaction and Organizational Commitment as Predictors of Organizational Citizenship and in-role Behaviors, *Journal of Management*, 17(3): 601-617, doi: 10.1177/014920639101700305.

Weissinger, E. and Bandalos, D. L. (1995). Development, Reliability and Validity of a Scale to Measure Intrinsic Motivation in Leisure. *Journal of Leisure*, 27(4): 379-400.

Effectiveness of national sport organizations: Applicability and suitability of approaches to measuring effectiveness in the Czech Republic

Pavel Král, Stanislav Tripes, Petr Pirožek

Faculty of Management, University of Economics, Prague, Czech Republic

Abstract

Organizational effectiveness is one of the most controversial concepts in management theory and practice. There are many definitions of effectiveness and many ways how to measure it. However, there is a big demand of scholars and managers to measure effectiveness. Firstly, effectiveness is probably the most often used dependent variable of organizational and managerial research. And secondly, every manager should aim for effectiveness in his or her organization and many managers must demonstrate organizational effectiveness to its shareholders or stakeholders. In particular, Czech national sport organizations (NSOs) will probably face new pressures on showing their effectiveness, especially due to recent changes in the Czech sport environment. Thus, the paper explores five elementary approaches to measuring effectiveness of sport organizations and, evaluates applicability and suitability of the approaches for Czech NSOs. A mixed method was employed due to complex nature of the problem. A sequential equal status (QUAL-QUANT) research design was used. That is, a qualitative research was carried out at first and representatives of nine NSOs were interviewed. Next, quantitative research was done and a questionnaire survey was conducted. Data were obtained from 29 NSOs (n=67). The response rate was 43%, however, the sample demonstrate representativeness in all significant criteria. Data gathered through the survey were processed using SPSS software. The interviews affirmed the broad understanding of effectiveness as a concept. The managers of Czech NSOs differ a lot in defining effectiveness and they did not agree on a single criterion. The goal attainment approach is well established and was also used to evaluate NSOs. However, the focus of the approach is too narrow and moreover, some NSOs do not provide accurate data, since the approach is used for redistribution of subsidies. Thus, application of system resource approach provided a very good complementary data and showed significant differences between the NSOs in ability to acquire resources from own activities. The relations of goal attainment and system resource approach are analysed. The internal process approach and strategic constituencies approach were evaluated as appropriate for internal application while external applicability is impeded primarily by low transparency. The study revealed big differences among representatives of NSOs in considering effectiveness. The results suggest that goal

attainment approach and system resource approach should be used collaterally and together may provide good external view of organizational effectiveness. In addition, board members and managers should benefit from internal process approach (e.g. BSAQ) and strategic constituencies approach in their evaluating of their NSO.

Keywords: *Effectiveness, Non-profit effectiveness, National sport organization, Goal attainment approach, System resource approach.*

Introduction

Organizational effectiveness is one of the most controversial concepts in management theory and practice (Chelladurai, 1987). However, there is a big demand of scholars and managers to measure effectiveness what makes effectiveness a centre of discussions in the organizational research (Davis & Pett, 2002). Two main reasons to measure effectiveness were identified. Firstly, effectiveness is probably the most often used dependent variable of organizational and managerial research (Hosseini, Ramezani, Yosefi, Sajjadi, & Malekakhlagh, 2011). Secondly, Czech national sport organizations (NSOs) have been facing new pressures on proving their effectiveness, especially due to recent changes in the Czech sport environment. Hence, every manager of an NSO should aim for effectiveness in his or her organization and will have to demonstrate organizational effectiveness to its shareholders or stakeholders. Thus, the paper explores five elementary approaches to measuring effectiveness of sport organizations and, evaluates applicability and suitability of the approaches for Czech NSOs.

The controversy of all the disputes can be identified in heterogeneity of the definitions. In the context of organizational theory as a whole, it is very difficult to find a common definition of effectiveness (Shilbury & Moore, 2006). Majority of definitions is connected with goals of the organization. For example, effectiveness is defined as “extent to which organization achieve its goals” (Pedersen, Parks, Quarterman, & Thibault, 2010, p. 76; Slack & Parent, 2006, p. 38) or, “the accuracy and completeness with which users achieve certain goals” (Frøkjær, Hertzum, & Hornbæk, 2000, p. 345). On the contrary, some definitions are focused not on goals, but on the resources of the organization. In such case, effectiveness “refers to the resource-getting ability of an organization” (Davis & Pett, 2002, p. 87). Even though, all the definitions and all the studies using effectiveness aim to differentiate better working organizations from the worse working. Herman and Renz (2008) advocate that effectiveness is a social construct dependent on the evaluator which is partially in compliance with Brown (2005) who states that the effectiveness is derived from the approach to measure. For this reason, five common approaches to measuring effectiveness are introduced.

There are five generally accepted approaches to effectiveness. First, the goal attainment approach is the oldest approach (Price, 1968) and is based on identifying and assessing organizational goals. This approach is broadly accepted for elite sport evaluation but on the other hand, this approach fails when evaluating achieving of other sport organizational goals (Shilbury & Moore, 2006). Second, the system resource approach is focused on monitoring the organizational resources which comprise financial and material resources, membership (Hossein et al., 2011) or even reputation, goodwill or knowledge (Slack & Parent, 2006). The advantage of the system resource approach is a possibility to compare different organizations. The problem of the approach is perceived in the relation of resources and achieving the goals of the organization which is disputed by some authors (Hodge & Piccolo, 2005). Third, the internal processes approach proceeds from assumption that harmonic and effective internal environment leads to better working organization. The most used method of the approach is measuring of effectiveness of the board (Hoye & Cuskelly, 2007). Fourth, the strategic constituencies approach evaluates the effectiveness upon assessment of key stakeholders. This approach provides the vision of effectiveness as a reflection of entire work of the organization, however all the stages of stakeholder approach must be completed what makes the approach very demanding (Slack & Parent, 2006). Fifth, the competing values approach does not evaluate the outcomes, but compliance with specified set of values (Quinn & Rohrbaugh, 1981).

Methods

A mixed method was employed due to complex nature of the problem. A sequential equal status (QUAL-QUANT) research design was used (Johnson, Onwuegbuzie, & Turner, 2007; Leech & Onwuegbuzie, 2009). That is, a qualitative research was carried out at first and representatives of nine NSOs were interviewed. Those representatives comprised heads of the boards and CEOs and, were chosen using purposive sampling (Teddlie & Yu, 2007). The criteria for sampling covered size (three large, three big and three small NSOs), transparency (three transparent, three quasi-transparent and three non-transparent NSOs (Král, 2011a), Olympic and non-Olympic NSOs (five Olympic and four non-Olympic NSOs), and team and individual sports (four team and five individual sports NSOs). Thus, representativeness was achieved in all substantial criteria characterising NSOs.

In the second phase, quantitative research was done and a questionnaire survey was conducted. The questionnaire comprised two main parts. First part surveyed elementary characteristics about the NSOs and second part was focused on the system resource approach variables, particularly number of professional staff and economic indicators derived from income statement. The survey was initiated by phone contact

and was followed by providing the questionnaire by e-mail. Data were obtained from 29 NSOs (n=67). The response rate was 43%, however, the sample demonstrate representativeness in all significant criteria. Data gathered through the survey were processed using SPSS software.

Results

The NSOs representatives diverged substantially in evaluating the effectiveness. After a definition of effectiveness they were asked to give criteria of effectiveness they had been using or would have used to assess effectiveness. Then, criteria corresponding with the five main approaches were discussed to obtain the opinion of NSO representatives about the criteria and the approaches. Surprisingly, only a single representative stated sport success as a major criterion of effectiveness what is in contrast to the Ministry of Education, Youth and Sport framework which reflects mostly sport success. Sport success is also one of the main criteria in redistribution of state subsidies. Hence the system redistribution of state subsidies mirrors the goal attainment approach. Despite the majority of interviewed NSO representatives admitted the importance of evaluating sport success they often doubted the ability to compare different NSOs in context to differences in various kinds of sports. Furthermore, comparing the same NSO in different countries was considered to be easier than comparing different NSOs in a single country. One of the reasons identified behind was a very narrow scope of the goal attainment approach which does not reflect the entire activity of NSOs. This finding reveals that the goal attainment approach is broadly used but is not considered as an all-embracing concept.

Some representatives doubted criteria of the system resource approach what was based on their experience with false reporting of membership. That is because membership is also one of the criteria that help NSOs to acquire state subsidies and, some NSOs do not provide accurate data. On the other hand, some representatives did not perceive membership as a source of own resource despite the results revealed that membership fees can form a substantial source of revenues. Thus, the application of system resource approach brought interesting results and provided a very good complementary data which proved significant differences between the NSOs in ability to acquire resources from own activities.

Few representatives also agreed that evaluating of impact or evaluating of stakeholders can give an interesting point of view on effectiveness but they diverged in criteria of impact or, they enumerated different stakeholders. Using the strategic constituencies approach was evaluated as beneficial but very difficult to conduct. Moreover, two new sources of effectiveness were also mentioned. First, the effectiveness can be affected

by relations of board members and government members (by getting extra financial support) and second, remarks about the relation of education of board members to effectiveness of NSO were made. Those two new sources of effectiveness point at the system resource approach which is, however, very difficult to conduct externally.

Quantitative part of the research enabled to examine the relationships among variables used for goal attainment approach and system resource approach. Correlations of selected variables of effectiveness are depicted in table 1. Absolute variables (sport success (Sp) and membership (Mm) representing goal attainment approach and, number of staff (St), grants and subsidies (G) and resources generated by own activity of NSO (OA) representing system resource approach) are mostly significantly correlated. Thus, the results generally confirmed relation between the goal attainment and system resource approach. On the other hand, there are no significant correlations of relative variables (ratio of resources from own activity on total revenues (OA/T) and ratio of membership fees on total revenues (T/Mm) and membership fee per member). The distribution of these three variables is very uneven and this points at different availability to acquire own resources which is not in relation to any goal attainment variable. To sum up, there is a relation between goal attainment approach and government grants and subsidies only. The goal attainment approach is not in relation to ratio of own resources to total resources and also not to relation to ability to acquire membership fees.

Tab. 1 Correlations of selected effectiveness variables (results)

		Sp	Mm	St	G	GT	OA	OA/T	T/Mm	Mf
Sport success (Sp)	Pears. Corr.	1	.408**	.676**	.824**	.377	.441*	-.377	-.131	-.179
	Sig.(2-tailed)		.002	.000	.000	.057	.024	.057	.523	.383
	N	56	56	31	26	26	26	26	26	26
Membership (Mm)	Pears. Corr.	.408**	1	.783**	.510**	-.209	.748**	.283	-.187	.451*
	Sig.(2-tailed)	.002		.000	.005	.269	.000	.136	.332	.012
	N	56	66	36	29	30	29	29	29	30
Nr. of staff (St)	Pears. Corr.	.676**	.783**	1	.899**	.222	.717**	-.161	-.039	.177
	Sig.(2-tailed)	.000	.000		.000	.238	.000	.404	.842	.349
	N	31	36	36	29	30	29	29	29	30
Grants & subsidies (G)	Pears. Corr.	.824**	.510**	.899**	1	.317	.616**	-.317	-.047	-.042
	Sig.(2-tailed)	.000	.005	.000		.094	.000	.094	.807	.830
	N	26	29	29	29	29	29	29	29	29
Grants & subsidies/ Total income (G/T)	Pears. Corr.	.377	-.209	.222	.317	1	-.290	-1**	-.142	-.284
	Sig.(2-tailed)	.057	.269	.238	.094		.127	.000	.463	.129
	N	26	30	30	29	30	29	29	29	30
Own activity resources (OA)	Pears. Corr.	.441*	.748**	.717**	.616**	-.290	1	.290	.177	.349
	Sig.(2-tailed)	.024	.000	.000	.000	.127		.127	.358	.064
	N	26	29	29	29	29	29	29	29	29
Own activity resources / Total income (OA/T)	Pears. Corr.	-.377	.283	-.161	-.317	-1**	.290	1	.142	.393*
	Sig.(2-tailed)	.057	.136	.404	.094	.000	.127		.463	.035
	N	26	29	29	29	29	29	29	29	29
Total income/ membership (T/Mm)	Pears. Corr.	-.131	-.187	-.039	-.047	-.142	.177	.142	1	-.144
	Sig.(2-tailed)	.523	.332	.842	.807	.463	.358	.463		.457
	N	26	29	29	29	29	29	29	29	29
Membership fee (per member) (Mf)	Pears. Corr.	-.179	.451*	.177	-.042	-.284	.349	.393*	-.144	1
	Sig.(2-tailed)	.383	.012	.349	.830	.129	.064	.035	.457	
	N	26	30	30	29	30	29	29	29	30

** . Correlation is significant at the 0.01 level.

* . Correlation is significant at the 0.05 level.

Discussion

Conducting such a study in in the Czech Republic (and most probably in any of CEE countries (Wright, Buck, & Filatotchev, 2005) was affected by low transparency, because it made difficult to obtain data generally available in countries with developed sport governance such as Australia (Král, 2011b). As a result, low transparency required quantitative survey to collect data which – in compliance with codes of good governance (e.g. Australian Sports Commission, 2005; European Non-Governmental Sports Organisation, 2000; National Council for Voluntary Organisations, 2005) – should be easily available. The results of quantitative part of the survey may be affected by bias towards more transparent NSOs. Hence, possible direction of future studies was identified in examination of relation between effectiveness and compliance with principles of good governance. Particularly, the causes and impact of transparency should be examined.

The study examined applicability of all basic approaches to measuring effectiveness. The data were collected for the goal attainment approach and the system resource approach because these two approaches were identified as an applicable framework for external and extensive evaluation of effectiveness. Using this combination, the special attention should be given to resources from own activity. On the other hand, comparison of all the approaches in a case study of one or few NSOs could provide new perspective and thus is recommended for future studies.

Conclusions

The study proved the controversy of perception of effectiveness and revealed that practitioners show even larger discrepancy than scholars do. The representativeness of NSOs did not agree on a single criterion of effectiveness and even questioned the possibility of comparing NSOs in different kinds of sport. Nevertheless, the goal attainment approach is dominantly used for external evaluation by government or governing bodies and therefore must be accepted by NSOs managers. The results also confirmed general relation between the goal attainment and the system resource approach. At the same time, it is important to emphasize differences in the structure of resources because capability to acquire own resources and mainly membership fees is not in relation to achieving the common goals. Therefore the board members and managers should focus not only on total resources but especially on capability to acquire own resources. In addition, internal application of the internal process approach and the strategic constituencies approach would bring the NSOs valuable assessment of board effectiveness and opinions of stakeholders.

Reference

- Australian Sports Commission. (2005). *Governing sport: The role of board, a good practice guide for sporting organisations*. Canberra, Australia: Australian Sports Commission.
- Brown, W. A. (2005). Exploring the association between board and organizational performance in nonprofit organizations. *Nonprofit Management and Leadership*, 15(3), 317-339.
- Davis, P. S., & Pett, T. L. (2002). Measuring organizational efficiency and effectiveness. *Journal of Management Research*, 2(2), 87-97.
- European Non-Governmental Sports Organisation. (2000). *Transparency and credibility in sports organizations: European Non-Governmental Sports Organisation*.
- Frøkjær, E., Hertzum, M., & Hornbæk, K. (2000). Measuring usability: are effectiveness, efficiency, and satisfaction really correlated? *CHI Letters*, 2(1), 345-352.
- Herman, R. D., & Renz, D. O. (2008). Advancing nonprofit organizational effectiveness research and theory: Nine theses. *Nonprofit Management and Leadership*, 18(4), 399-415.
- Hodge, M. M., & Piccolo, R. F. (2005). Funding source, board involvement techniques, and financial vulnerability in nonprofit organizations: A test of resource dependence. *Nonprofit Management and Leadership*, 16(2), 171-190.
- Hosseini, E., Ramezani-neghad, R., Yosefi, B., Sajjadi, S. N., & Malekakhlagh, E. (2011). Compressive review of organizational effectiveness in sport. *Choregia: Sport Management International Journal*, 7(1), 5-21.
- Hoye, R., & Cuskelly, G. (2007). *Sport governance*. Oxford, U. K.: Elsevier.
- Chelladurai, P. (1987). Multidimensionality and multiple perspectives of organizational effectiveness. *Journal of Sport Management*, 1(1), 37-47.
- Johnson, R. B., Onwuegbuzie, A. J., & Turner, L. A. (2007). Toward a definition of mixed methods research. *Journal of mixed methods research*, 1(2), 112-133.

Král, P. (2011a). Is sport governance secret? Exploratory study of transparency within Czech national sports organizations. Paper presented at the Sport and Quality of Life, Brno, Czech Republic.

Král, P. (2011b). Sport governance here and down under: Comparison of Czech and Australian canoeing national sport organizations. Paper presented at the Vědecká konference doktorandů a mladých vědeckých pracovníků [Conference of Higher Degree Researchers], Jindřichův Hradec, Czech Republic.

Leech, N. L., & Onwuegbuzie, A. J. (2009). A typology of mixed methods research designs. *Quality & quantity*, 43(2), 265-275. doi: 10.1007/s11135-007-9105-3.

National Council for Voluntary Organisations. (2005). *Good governance: A code for the voluntary and community sector*. London, UK: National Council for Voluntary Organisation.

Pedersen, P. M., Parks, J., Quarterman, J., & Thibault, L. (2010). *Contemporary Sport Management*. Leeds, UK: Human Kinetics Publishers.

Price, J. L. (1968). The study of organizational effectiveness. *Sociological Quarterly*, 13, 3-15.

Quinn, R. E., & Rohrbaugh, J. (1981). A competing values approach to organizational effectiveness. *Public Productivity Review*, 5(2), 122-140.

Shilbury, D., & Moore, K. A. (2006). A study of organizational effectiveness for National Olympic Sporting Organizations. *Nonprofit and voluntary sector quarterly*, 35(1), 5-38.

Slack, T., & Parent, M. M. (2006). *Understanding sport organizations: the application of organization theory* (2nd ed.). Champaign, IL: Human Kinetics.

Teddle, C., & Yu, F. (2007). Mixed methods sampling: A typology with examples. *Journal of Mixed Methods Research*, 1(1), 77-100.

Wright, M., Buck, T., & Filatotchev, I. (2005). *Corporate governance in transition economies Corporate governance. Accountability, enterprise and international comparison* (pp. 415-445). Chichester: John Wiley & Sons.

Socio-economical Differences between Hungarian Sport Consumers

David Paar

Faculty of Economics, University of West Hungary, Sopron, Hungary

Abstract

The paper searches the differences between the groups of Hungarian households regarding the sport expenditures' measure in household budget and determining factors. The main goal of the paper is to separate typical types of households based on their sport expenditures. There could be a difference not only in the chance of presence of sport expenditures but in the measure of sport expenditures between these typical groups of households. We used the Household Budget Survey 2008 of the Hungarian Central Statistical Office which contains data of more than 7000 households. Our method was Heckit model, where the possibility and measure of sport expenditures was explained in households' budget. Heckit model consists of two different parts, the first one is a qualitative equation (Probit model) and the second one is a quantitative equation. The increase of the following indicators has a positive effect onto the measure of the sport expenditures: income status, level of education, size of settlement. The increase of the number of children and the age of the households' heads have a reversed effect onto the measure of sport expenditures. The sex of the household's head doesn't play a significant role. The results of the paper make it possible for potential sport political decision makers to make their decisions responsible about the demand side of Hungarian sport market. Based on this research the main target groups can be marked which should be targeted to generate a significant growth in the income of sport companies and sport suppliers. The most disadvantageous groups are marked too which need more support to play a significant role on the sport market. In the future this research should be expanded with additional variables (e.g. quality of sport supply, attitudes of consumers, socialisational properties, and social status) which have been used in foreign researches. The present Hungarian databases however, do not contain these variables or they contain them only partially. A new database should be created in the future which could contain not only the sport expenditures after COICOP nomenclature but much more detailed expenditures using the present research's methodology and statements as well.

Keywords: *sport expenditures, Heckit model, socio-economic factors, household budget survey.*

This research was supported by the European Union and the State of Hungary, co-financed by the European Social Fund in the framework of TÁMOP 4.2.4. A/2-11-1-2012-0001 'National Excellence Program'.

Introduction

Sport economic researches have more and more popularity all around the world, the sport market is a recognized segment in the national economy of countries with a long range market economy history. (Ács, 2009) This could be the reason why it became a popular research field, a fact which is supported by the growing number of publications and journals. Hungarian sport economic researches can help a similar process in Hungary too to modernize the Hungarian sport sector because Hungarian sport sector still has a lot of properties based on the socialist era. (Bakonyi, 2010) An effective sport life and a well working sport market are unimaginable without getting rid of these properties. The present study wants to open a newer segment of sport economics researches in Hungary.

The paper focuses on residential sport consumption using a microeconomic approach with a special view of the structural changes in the Hungarian households' budget.

It is becoming more and more accepted by the decision makers, that sport and active lifestyle is a suitable tool for improving both quality of life and living standard. It is able to produce national economic utilities too. (Ács et al., 2011) This is supported by the fact that sport is treated like a strategic sector in the political field as well and it has an important long term switch from the status of a sport nation into a sporting nation. (Sport XXI. National Sport Strategy, 2007)

Using a panel analysis the paper examines the possibility of classifying household types on the basis of the differences in sport expenditures. The author wants to find out the variance of chance in presence of sport expenditures in households' budget between the households' types and wants to know which of them has a higher absolute value in sport expenditures.

The main goal of this research is to get concrete, detailed results for professionals and potential political decision makers and enable them to make valid decisions related with one of the most important actors in the sport market.

Methods

Heckit regression model was used to analyse the structure of the Hungarian households' budget. The model consist of two parts: a quality and a quantity equation. (Heckman, 1976)

First of all the possibility of sport expenditures' presence in households' budget was calculated with the help of a selectivity equation. This meant the usage of a Probit model assuming the existence of a latent regression model.

The latent regression has to model the change in utility of a person who has to choose between two alternatives (to spend on sport [$y_i=1$] or not to spend on it [$y_i=0$]). The person takes into consideration both alternatives (it is U^a at $y_i=1$ and U^b at $y_i=0$) and decides depending on possible utilities. He will spend on sports if $U^a > U^b$ and he will not spend on sports if $U^a < U^b$. These perceptions of utility are not observable so they are called a latent variable (y_i^*). Only the binary result of decision is observable which means that $y_i=1$ if he spends on sport and $y_i=0$ if he does not.

Only the data of households with sport expenditures were used in the second stage of the Heckit model (this was the quantity equation). The measure of these values was modelled in this second stage. Further estimations were made only on this selected sample and Mill's inverse ratio for all units was also added to the estimator function too.

$$w_i = \begin{cases} w_i^* , & \text{ha } y_i^* > 0 \\ 0 & , \text{ha } y_i^* \leq 0 \end{cases}$$

where w_i is the observed value of estimated expenditures.

The marginal effects could be estimated after running the two stages of the Heckit model. (Sigelman – Zheng, 1999; Dow – Norton, 2003) These marginal values made it possible to interpret the differences between the categories of households and to decide the potential change in presence possibility and the magnitude of sport expenditures in case a household moved into a different category.

A Logit model was calculated parallel with the Heckit model. The latter differs only in the specification of its error term so it showed similar results. However, this type of model made it possible to calculate the probability quotients showing the probability of sport expenditures' presence in the different household categories compared to the reference category. (Székelyi-Barna, 2005)

Hungarian Household Budget Survey (HBS) made by the Hungarian Central Statistical Office (HCSO) from year 2008 was used by the author to run Heckit model of sport consumption.

HBS is representative for Hungarian households from the following aspects: regional situation; type of settlement; age, sex, educational level and economic activity of the household's head.

The consumptional structure of households is categorized by the internationally accepted COICOP (Classification of Individual Consumption according to Purpose) nomenclature, the following elements of which were used in the research.

Tab. 1 Types of Sport Expenditures Used in the Research with their COICOP Codes

COICOP-code	Type of expenditure
9	Free time and culture
92	Durable goods for other free time and cultural activities
921	Durable goods for outdoor free time activities
92110	<i>Durable goods for sport and camping activities</i>
92311	<i>Pieces of durable sport goods and musical instruments</i>
92312	<i>Reparation of durable sport goods and musical instruments</i>
93	Games, hobby and sport goods, gardening, pets
932	Sport equipments, camping goods and other equipments for outdoor free time activities
93210	<i>Equipments of sport and camping activities</i>
94	Services of free time and cultural activities
941	Services of sport and free time activities
94111	<i>Sport events, entrance fees</i>
94112	<i>Sport, music and dancing courses</i>
94113	<i>Other free time services</i>

Source: homepage of HCSO (www.ksh.hu)

Some of the explanatory variables were converted into new variables in order to be able to use a smaller number of categories, and improve the significance level of the analysis. The explanatory variables were the following: age, sex, educational level and economic activity of the household's head, number of children under 20 in the households, region and settlement of the household and net income.

Results

The Heckit model was run with software GRETL. The goodness of fitting is measured with McFadden R²: 0.212. The rate of correctly predicted items is 83.7 %, the likelihood-rate is significant under 1 %. Collinearity had been tested with Variance Inflation Factor, and it was not present in the model.

Tab. 2 Summary Table about the Results of Heckit Model

	Quality equation			Quantity equation	
	<i>Coefficient</i>		<i>Marginal effect</i>	<i>Coefficient</i>	
const	-2.80202 (-25.9295)	***		4.331888 (2.66)	***
BP	0.613483 (7.094)	***	0.149783	1.249028 (4.73)	***
CS	0.326625 (5.7232)	***	0.0714555	0.621434 (3.41)	***
OC	0.183236 (3.3502)	***	0.0379985	0.2921704 (2.12)	**
VILL					
CHILD12	0.410096 (8.2852)	***	0.089461	0.3666297 (1.88)	*
CHILD34	0.537053 (6.172)	***	0.137208	0.4338701 (1.62)	
CHILD5	0.196375 (0.7543)		0.043344	0.2492222 (0.46)	
CHILD0					
REGIO_MDTRD	0.161757 (1.8064)	*	0.0344248	out from the quantity equation because of methodological reason	
REGIO_WTRD	0.0415283 (0.4497)		0.00836745		
REGIO_STRD	0.0269212 (0.2825)		0.0053876		
REGIO_NHUN	-0.130189 (-1.4951)		-0.0243391		
REGIO_NGP	0.126231 (1.4774)		0.0263095		
REGIO_SGP	0.0211332 (0.2495)		0.00421131		
REGIO_MDHUN					

AGE24	1.06787 (7.2754)	***	0.332352	1.952326 (3.47)	***
AGE2534	0.774206 (9.5808)	***	0.206937	1.101588 (2.82)	***
AGE3544	0.850539 (10.7019)	***	0.221665	1.379715 (3.34)	***
AGE4554	0.486486 (6.5587)	***	0.111449	0.8884917 (3.11)	***
AGE5564	0.206797 (2.7558)	***	0.0435175	0.4415548 (2.14)	**
AGE65					
SCHOOL2	0.350531 (7.4128)	***	0.0760186	0.5948232 (3.44)	***
SCHOOL3	0.643086 (11.972)	***	0.158049	1.142555 (4.18)	***
SCHOOL1					
MALE	-0.011151 (-0.2252)		-0.0022082	-0.0010666 (-0.01)	
FEMALE					
NINC	0.193141 (11.1112)	***	0.0381561	.4233416 (4.75)	***
lambda	only in quantity equation			1.491137 (2.65)	***
<i>McFadden R²</i>	0.212403			<i>Average of dependent variable</i>	10,17258
<i>Number of correctly predictions</i>	83.7% (6404)			<i>Standard error of dependent variable</i>	1,27751
<i>Log-likelihood value</i>	-2802.841			<i>rho</i>	1,7235036
<i>Likelihood-rate, χ^2 (21)</i>	1511.77 [0.0000]			<i>sigma</i>	0,86518

in bracket: z-scores; *** – significant on 1% level; ** – significant on 5% level; * – significant on 10% level
 BP: Budapest; CS: county seat; OC: other city; VILL: village; CHILD12: 1 or 2 children; CHILD34: 3 or

4 children; CHIL5: 5 or more children; CHIL0: no children; REGIO_MDTRD: Middle Transdanubia; REGIO_WTRD: West Transdanubia; REGIO_STRD: South Transdanubia; REGIO_NHUN: North Hungary; REGIO_NGP: North Great Plain; REGIO_SGP: South Great Plain; MDHUN: Middle Hungary; AGE24: 24 or under 24 years; AGE2534: between 25-34 years; AGE3544: between 35-44 years; AGE4554: between 45-54 years; AGE65: 65 or more years; SCHOOL2: graduation or other middle educational level; SCHOOL3: diploma or higher education; SCHOOL1: 8 classes or less educational level; MALE: male head of household; FEMALE: female head of household; NINC: net income category; Source: own calculation

The binary logit model was run in the software SPSS to calculate the rate of chance for the single variables too. The results, the coefficients and the significance levels are very similar to the quality equation, these are not presented in this paper, only the rate of chance is published.

Tab. 3 Rates of Chance for Presence of Sport Expenditures Resulted from the Logit Model

Settlement (VILL)	Exp(B)	Region (MDHUN)	Exp(B)	Age group (AGE65)	Exp(B)	Number of children (CHILD0)	Exp(B)
BP	2.871	MDTRD	1.299	AGE24	7.525	CHILD12	2.034
CS	1.778	WTRD	1.036	AGE2534	4.5	CHILD34	2.594
OC	1.371	STRD	1.024	AGE3544	5.11	CHILD5	1.495
		NHUN	0.778	AGE4554	2.754		
		NGP	1.23	AGE5564	1.623		
		SGP	1.007				
Educational level (SCHOOL1)	Exp(B)	Sex of the household's head (FEMALE)	Exp(B)	Net income category		Exp(B)	
SCHOOL2	1.899	MALE	0.997			1.408	
SCHOOL3	3.147						

BP: Budapest; CS: county seat; OC: other city; VILL: village; CHILD12: 1 or 2 children; CHILD34: 3 or 4 children; CHIL5: 5 or more children; CHIL0: no children; REGIO_MDTRD: Middle Transdanubia; REGIO_WTRD: West Transdanubia; REGIO_STRD: South Transdanubia; REGIO_NHUN: North Hungary; REGIO_NGP: North Great Plain; REGIO_SGP: South Great Plain; MDHUN: Middle Hungary; AGE24: 24 or under 24 years; AGE2534: between 25-34 years; AGE3544: between 35-44 years; AGE4554: between 45-54 years; AGE65: 65 or more years; SCHOOL2: graduation or other middle educational level; SCHOOL3: diploma or higher education; SCHOOL1: 8 classes or less educational level; MALE: male head of household; FEMALE: female head of household; NINC: net income category; Source: own calculation

The possibility of aggregated sport expenditures' presence in households' budget and its measure increase with the growing degree of urbanization. Growing num-

ber of children under 20 in households produces a higher presence possibility in aggregated expenditures, however it has no influence on the measure of expenditures. Households in the Central Transdanubian region have the highest possibility in aggregated sport expenditures. There is a life-cycle adequate fluctuation in the presence possibility of aggregated and sport expenditures. This means that the youngest age-group spends on sports with the highest probability then a fall back is observable in the next age-group. An increase is observable in the third age-group, however it means a lower possibility compared to the youngest group. The lowest possibility of expenditures can be observed in the oldest age-groups. The effect of life-cycle changes the linearity in the measure of aggregated sport expenditures too. Improvement of educational level increases the presence possibility of expenditures. This statement is also true for the measure of aggregated sport expenditures. There is no significant difference between the presence possibility and measure of household with man or woman head in all of the expenditure categories. Improvement of households' income situation also results an increase in presence possibility and measure in all sport expenditures.

Discussion

The consumer groups living in a more urbanized settlement have a better possibilities to do any sport activities because of the better sport supply of sport. (Poupaux – Breuer, 2009) But sedentary lifestyle typical in these settlements calls for much more physical activities in free time.

Households with children have much more presence possibility of sport expenditures but their measure is not yet favourable, the reason of which could be the permanently growing expenses of educating children.

Age specialties are also determinants of sport expenditures' tendency. Although willingness to do sport of younger age groups is higher it is worthwhile to focus on the older age-groups as well. Their attitudes are much more difficult to change because of their age but it was recognized in the Western countries, that older groups' quality of life can be considerably improved by adequate sport supply. (Rejeski – Mihalko, 2001)

Better educated people can afford the luxury of sport because of their better income situation and they are able to recognize its positive private externalities too. (Paár, 2011) The incentive sport programs could reach a wider range of this group, however, the undereducated groups should not be neglected either because of their disadvantageous situation.

The research was unable to disclose sexual or regional differences between the households so no overall statements can be formulated.

Conclusion

It is verified that income situation has a determining role for the presence possibility and the measure of sport expenditures. It has to be underlined that the tendency of sport expenditures and the tendency of doing sport activities – both active and passive participation – are not the same. However both of them have the same determining factors thus both can be used to draw conclusions about the tendencies of sport consumption. (Davies, 2002; Downward – Riordan, 2007; Földesi – Gál – Dóczi, 2008; Garcia et al., 2009; Humphreys – Ruseski, 2006; Lera-Lopez – Rapún-Garáte, 2005; Pawlowski, 2009, Perényi, 2011.)

We can suppose that the present economic crisis has an unfavourable effect on the household's sport consumption and the deterioration of income situation predicts a narrowing demand on sport markets. This could also have an unfavourable effect on the Hungarian population's health status in the long run. This could also lead to a possible narrowing supply caused by narrowing demand, a tendency which was observed in the last decades. All these factors could result in a self-inducing process, that less and less people could reach a wide range of sport services and the positive attitudes for sport activities could not evolve or only to a small extent. The present effort of the government to make children do sports during PE lessons in schools every day could be a great help. However, successful realization of this effort seems to be a little bit problematic because of the unsatisfying infrastructure.

Based on the panel analysis consumer groups can be identified which can be targeted by the corporate sector to reach higher profit. Other groups can also be identified which need incentives for a more active sport relevance.

References

Ács P. (2009): Nemzetközi és hazai sportgazdasági trendek. Hungarian Society of Sport Sciences Yearbook of Sportinnovation Committee 2009. Budapest.

Ács P. – Hécz. R. M. – Paár D. – Stocker M. (2011): A fitness (m)értéke – A fizikai inaktivitás nemzetgazdasági terhei Magyarországon. Közgazdasági Szemle, 58 (7-8) pp. 689-708.

Bykonyi T. (2010): Szabadidősport – élsport – politika. In: VII. Conference Book of Hungarian Congress of Sport Science. Budapest: Hungarian Society of Sport Science.

Davies E. L. (2002): Consumers' Expenditure on Sport in the UK: Increased Spending or Under-estimation? *Managing leisure: an international journal*, 7 (2) pp. 83-102.

Dow W. H. – Nortone E. C. (2003): Choosing Between and Interpreting the Heckit and Two-Part Models for Corner Solutions. *Health Services & Outcomes Research Methodology*, 4 pp. 5-18.

Downward P. M. – Riordan J. G. (2007): Social Interactions and the Demand for Sport An Economic Analysis. *Contemporary Economic Policy*, 25 (4) pp. 518-537

Földesiné Szabó GY. – Gála. – Dóczy T. (2008): Társadalmi riport a sportról 2008, Budapest: Ministry of Local Government Sport Secretariat – Hungarian Society of Sport Science. pp. 124.

Garcia J. – Lera-López F. – Suárez M. J. (2009): Estimation of a Structural Model of the Determinants of the Time Spent on Physical Activity and Sport: Evidence for Spain. Universidad de Oviedo, Departamento de Economica. <http://www.unioviado.es/economia/EDP/EDP0209.pdf>

Heckmann J. J. (1976): The Common Structure of Statistical Models of Truncation, Sample Selection and Limited Dependent Variables and a Simple Estimator for Such Models. *Annals of Economic and Social Measurement*, 5 (4), pp. 120-137.

Humphreys B. R. – Ruseski J. E. (2006): Economic Determinants of Participation in Physical Activity and Sport. Working Paper Series, Paper No. 06-13, North American Association of Sport Economists. http://www.holycross.edu/departments/economics/RePEc/spe/HumphreysRuseski_Participation.pdf

Lera-López F. – Rapún-Gárate M. (2005). Sports participation versus consumer expenditure on sport: Different determinants and strategies in sport management. *European Sport Management Quarterly*, 5 (2) pp. 167-186.

Paár D. (2011): The Income and Price Dependency of the Hungarian Sport Goods Consumption – *Periodica Polytechnica Social and Management Sciences*, 19 (1) pp. 11-17.

Pawlowski T. (2009): Die Dienstleistungsnachfrage im Freizeitsektor – Eine ökonomische Modellierung des Ausgabenverhaltens von Privathaushalten in Deutschland auf Basis von Daten der Laufenden Wirtschaftsrechnungen. Köln: Deutschen Sporthochschule Köln. pp. 323.

Perényi SZ. (2011): Sportolási szokások: Sportolási esélyek és változástrendek. pp. 159-184. In.: Bauer B. – Szabó A. (ed.): *Arctalan(?) Nemzedék. Belvedere Meridionale*, Szeged. pp. 391.

Poupaux S.–Breuer C. (2009): Does Higher Sport Supply Lead to Higher Sport Demand? A City Level Analysis. Working Paper Series, Paper No. 09-05, North American Association of Sport Economists. http://www.holycross.edu/departments/economics/RePEc/spe/PoupauxBreuer_SupplyDemand.pdf

Rejeski W. J. – Mihalko S. L. (2001): Physical Activity and Quality of Life in Older Adults. *The Journal of Gerontology* 56 (2) pp. 23-35.

Sigelman L. – Zheng L. (1999): Analyzing censored and sample-selected data with Tobit and Heckit models. *Political Analysis* 8 pp. 167-182.

Sport XXI National Sport Strategy. 65/2007. (VI. 27.) Parliament Decree.

Székelyi M. – Barna I. (2005): *Túlélőkészlet SPSS-hez*. Budapest: Typotex. pp. 453.

Contribution of gymnastic skills to the educational content of physical literacy in elementary school children and youth

Iveta Šimůnková, Viléma Novotná, Jan Chrudimský

Faculty of Physical Education and Sport, Charles University in Prague, Czech Republic

Abstract

Cultivation of fundamental movement skills, i.e. “physical literacy”, is one of the crucial preconditions of any physical activity that brings health benefits and improves the level of physical condition. The basic physical literacy is strongly influenced by gymnastic skills which create the foundations for safe and correct performance of all subsequent physical and sport activities. In gymnastics, the expression of movement is based on conscious control of movement that leads to an optimal performance of body or body parts movements.

In this article, we use the methods of content analysis and comparison of expert publications focusing on physical education and sport preparation of elementary school children to propose concrete fundamental gymnastic skills from various areas of the set of gymnastic activities. The proposal of activities includes following sets: body posture exercises as a universal starting position for movement, exercises for optimal performance of basic locomotion, performance of body and body parts movements, space orientation, keeping the static and dynamic balance, acrobatic (motor-functional) preparation, technique of exercises without hand apparatus, technique of basic manipulation skills, technique of apparatus exercises, acrobatics, music-movement education. Selected movement skills acquired through discussed activities significantly develop the competencies mentioned in the educational programs.

Keywords: *gymnastics, movement base, activities, inventory of gymnastic skills.*

The article was written in the framework of the scientific branch development programme UK FTVS n. 39 Social-Sciences Aspects of Human Movement Studies and it was supported by the Specific university research grant project no. 2013-297603.

Introduction

In the educational environment, the term “literacy” (meaning a competence for human activities) can be encountered with increasing frequency. The concept of “literacy” has been approached in various areas of human endeavor as a necessary base level of general and specific knowledge and skills. “Physical literacy” can be defined by delimiting

individual movements and creating an inventory of physical activities that need to be acquired and efficiently implemented in any physical activity that harmonically influences the personality of an individual on the psychosocial level, motivates to life-long physical self-actualization, incites the need to be active and increases the level of general physical activity.

Various Czech and international authors published articles focusing on the approach towards physical education and discussed its relation to physical literacy. For example, Whitehead (2001, 2010) or Whitehead and Murdoch (2006) comprehensively analyzed the physical literacy, Stafford and Balyi (2005) studied elementary physical competencies and sport skills, LTAD system (Long-Term Athlete Development, 2008) delimited basic movement competencies and skills for various levels of long-term athlete development. In the Czech context, this topic has been studied by, for example, Bukač and Dobrý (2008), Čechovská and Dobrý (2010), Šimůnková, Novotná, Vorálková (2010). The term “movement base” has also been used by Süss (2008).

Defining the concrete content of physical literacy is especially important for preschoolers and school children and youth. The main attention should focus on mastering basic postures, movements, and movement patterns that will serve as a “movement base” for safe and correct performance of other physical activities and sports. When teaching these activities, it is necessary to adjust the didactic approach to individual predispositions of the child, use gameplay and reinforce an individual expression of the movement.

On the introductory level of physical education, it is most suitable to use gymnastics because it has traditionally focused on physical and sport education of children and youth in school physical education and in the area of “sport for all”. Gymnastics allows composing a concrete set of gymnastic activities for a particular age group as it has got available a system of classification of gymnastic activities and an expert gymnastic terminology describing the movements. Gymnastic exercises focus on the quality of movement and they are based on the conscious control of movements (as opposed to mere imitation) leading to optimal execution of body and body parts movements in performing the technique. We suppose that well-learned gymnastic skills bring feelings of satisfaction, support self-consciousness, allow positive experiences with physical activity and movement performance, and, at the same time, provide the most efficient motivation for sustaining physical activity.

Methods

The main aim of this article is to select inventory of gymnastic skills from parts of the set of gymnastic activities that influence the content of physical literacy of preschool and elementary school children. Based on content analysis of expert publications on physical education and sport preparation, we compared the conclusions of these publications and selected concrete basic skills related to the introductory level of physical literacy. As the main sources for this comparison, the following published material (expert publications) were used: 1) selected chapters of the Framework Educational Programme for Pre-school Education (RVP, educational area Child and body, 2004); 2) the Framework Education Programme for Elementary Education (RVP, educational area Physical education, 2004); 3) and 4) Irish educational system, part “Infant” and 1st and 2nd grade (2010); 5) and 6) Canadian system LTAD Canadian Sport Centres (2008), part Active start (3-6 years) and „Fun, Fitness and Fundamental movement patterns“ (6-8 years); 7) Teaching children gymnastics (Werner, 2004); 8), 9) and 10) methodic materials for rhythmic (RG) and artistic gymnastics (AG) (1980, 1983, 1985); 11) a collection of exercises for children and youth (Dvořáková, 2006); 12) supplementary area Dance and movement education (2004); 13) structure of physical literacy for sport branch RG (Šimůnková, Novotná & Vorálková, 2010).

As supporting materials for the comparison and selection, we also used works of other authors (e.g. Galloway, 2007; Perič, 2008; Jasterjemskaia a Titov, 1998) as well as our practical experiences with implementation of preparation programs in gymnastic sports.

Apart from the content of the exercises, it is also necessary to emphasize the psychosocial benefits that the physical activity program and its implementation bring to participating individuals. These benefits include knowledge about movement, development of communication, nurturing the physical discipline and the sense of fair play, motivation to physical activity, and increasing self-confidence and self-actualization.

Physical literacy

Whitehead (2001) defines the term “physical literacy” as intrinsic motivation, self-confidence, determination, and a development of physical abilities and skills. Physical literacy can be characterized as conscious control of one’s body and readiness to perform physical movements and sport skills which bring joy and satisfaction to the performer, fulfill his or her biological needs and support his or her quality of life and healthy lifestyle. Therefore, physical literacy consists of elementary physical competencies and sport skills which create the base for every sport discipline (Stafford & Balyi, 2005).

The main goal of the gymnastic literacy is to acquire conscious mastery of basic movements creating appropriate “movement patterns” as a condition for their transfer to other specific gymnastic skills and also to skills in other physical and sport activities. Without mastering these fundamental skills, it is not possible to follow up with a quality and safe training of other, more difficult movements and harmonically develop the physical, social, and aesthetic aspects of the personality of the gymnasts. The selected set of gymnastics activities include: body posture exercises as a universal starting position for physical activity, training for optimal performance of basic locomotion, implementation of body and body parts movements in space, space orientation, keeping static and dynamic balance; selected exercises from acrobatic (motor-functional) preparation, technique of exercises without hand apparatus, technique of basic manipulation skills, technique of apparatus exercises, acrobatics, and music-movement education.

Results and Discussion

Gymnastics

Gymnastic exercises represent a suitable way of acquiring an ability of conscious and controlled movement and optimal performance of basic gymnastics skills. Equipment, such as various aids, hand apparatus and tools, is often used in gymnastic practice. Exercises are often performed with music which supports an optimal rhythm of movement, helps to regulate the movement, provides additional motivation, develops the movement memory, incites the initiative and creativity in children and allows for a positive experience of the movement. We propose exercises and skills inspired by selected set of gymnastic activities which form a suitable content of general physical literacy.

Results of the analysis

Content analysis of the documents has confirmed the selection of the activities in individual programs and their relation to the structure of gymnastic physical literacy (table 1).

Tab. 1 Relation of activity sets to individual educational programs

		Expert publications - see section Methods												
		1	2	3	4	5	6	7	8	9	10	11	12	13
Educational content	a	x				x	x		x		x	x	x	x
	b	x	x	x	x	x	x	x	x	x	x	x	x	x
	c	x	x	x	x	x	x	x	x	x	x	x	x	x
	d	x		x	x	x	x	x	x	x	x	x	x	x
	e	x		x	x	x	x	x		x	x	x	x	x
	f	x	x								x	x	x	x
	g	x	x	x	x	x	x	x	x	x	x	x	x	x
	h	x	x	x	x	x	x	x	x	x	x	x	x	x
	i		x	x	x	x	x	x	x	x	x	x		x
	j	x	x	x	x	x	x		x	x		x	x	
	k	x	x	x	x	x	x	x			x	x		x
	l	x	x	x	x	x			x	x	x	x	x	x

a – awareness of the body and self; b – body posture and balance; c – locomotion; d – control of body and body parts movement in space; e – orientation of body in space; f – acrobatic (motor-functional) preparation; g – exercise without hand apparatus; h – basics of acrobatics; i – manipulation with apparatus; j – apparatus exercise; k – music-movement education; l – specific knowledge

Set of gymnastic activities

Optimal body posture in starting positions is the base for correct performance of movements and for mastering more complex movement patterns. It is closely related to balance. Inventory of skills: standing positions (stand with feet together, stand with toes out, stand on tiptoes, stride and straddle stand, one foot stand, half squat and squat, lunge, gymnastics point (tendu)); kneeling positions (kneeling position on one knee, kneeling sit, straddle kneeling position, kneeling position on right or left extended forward, sideward, backward); sitting positions (sit with bent knees, straddle sit, sit with crossed legs); lying positions (lying positions with bent knees, straddle lying position, front, back or side lying position).

Locomotion allows for moving the body in space. The most common types of locomotion are various kinds of walking, running, jumps, dance steps, moving in low positions and locomotion on hands. Inventory of skills: walking (normal – forward, sideward and backward, walking on tiptoes, walking with a half squat swing, centripetal and centrifugal walk, gallop walk, hopping); running (normal, running with

bent knees, running on the tiptoes, running with knees up, running with shortened and prolonged step, running with changing speed and direction); gallop step, polka step, side gallop, hopping step, hopping step with rotation, crawling in low position, camel walk, crab walk).

Techniques of exercises without hand apparatus is a collection of basic gymnastic skills that follow an exact pattern of execution. They include body and body parts movements, movement in space, balance stand, turns, jumps, waves, figure eights, rotations and basic flexibility exercises. The movements are learned in the form of led, swing and wave movements. Inventory of skills: basic trunk movements – bends and turns; pelvis (hip) movements – tilt the pelvis to side, hip flips, pelvis circle; head movements – head bends, head turns; arm positions – leading arms, arm waves, isolated arm movements, asymmetrical arm movements; movements and positions of lower limbs; whole body waves; jumps – straight jump, bent jump (arch), jump with rotation, jump with one leg extension forward or backward; tuck jump, “cat jump”, “scissors”; balance positions – squat, tiptoe, stand with one knee up (passé), front scale; turns – turn with a steps, cross-legged turn, full turn; basic flexibility exercises – sitting (standing) deep forward bend, straddle sit with forward bend, “bridge”, stride split.

Acrobatic (motor-functional) preparation is a prerequisite for implementation of gymnastic skills. It is divided into several categories: firming up, supporting, taking of, landing, rotation, coordination, balance, flexibility, specific power and endurance (Zitko & Chrudimský, 2006). Acrobatic preparation is followed by the *acrobatics and technique of apparatus exercise*.

Examples from the inventory of skills: supported tuck, supported kneeling position, front support, forearms support, donkey kick, jumps from front support to supported tuck, lying with legs overhead (inverted pike), shoulder stand, back rocker, “the top”, side roll, forward roll, backward roll, cartwheel, balancing on shifting surface (hemisphere), climbing in a hanging, hand travel with straight arm on bars, climbing through and over an apparatus.

Technique of exercises with hand apparatus develops possibilities of manipulation with various objects and hand apparatus, control them in space, improve fine motor skills and hand grip. These skills include the ways of grips, transmissions (changing arms), leading in space (circles, semi-circles, eights), balancing objects, swinging, rotations, rolling on the ground and on body parts, striking and rebounding (off the ground, body, wall), jumping over, throwing, catching. Inventory of the skills: small balls – grip, transmissions, balancing, rolling, throwing catching, rebounding, kicking; rope – swinging, rotations, jumping, releasing one end, catching, throwing; hoop – grips, transmissions, rotations, spinning, rolling.

Music-movement education focuses on the harmony of music and movement, supports the rhythmic movement and movement creativity. Children learn: to express the rhythm and tempo by stepping and clapping, to switch between the state of tension and relaxation, spontaneous movement expressed by improvisation and folk dance.

Conclusion

Based on verified knowledge of the discipline of Gymnastics and a comparison with other documents concerned with physical education of children and youth, we identified a set of gymnastics activities which support general physical literacy. In a subsequent selection taken from the inventory of gymnastic skills we composed a proposal of gymnastic skills – specific skills transferable to other physical activities which significantly support the general physical literacy. When an individual correctly acquires the proposed content in the full range, we may expect that his or her physical literacy will grow and create the base for the development of sport achievements and the life-long motivation for physical activity.

References

- Berdychová, J., et al. (1980). Metodický dopis o cvičení dětí předškolního věku v oddílech MG. Praha: ÚV ČSTV.
- Bukač, L. & Dobrý, L. (2008). Dlouhodobý sportovní vývoj mládeže. Tělesná výchova a sport mládeže, 74 (4). 6-18.
- Canadian Sport Centres. (2008). Long Term Athlete Development (Gymnastics – the ultimate human movement experience). Vancouver: GCG.
- Čechovská, I. & Dobrý, L. (2010). Význam a místo pohybové gramotnosti v životě člověka. Tělesná výchova a sport mládeže, 76 (3). 2-5.
- Dvořáková, H. (2006). Pohybové činnosti pro předškolní vzdělávání. Praha: Raabe.
- Galloway, J. (2007). Děti v kondici. Praha: Grada Publishing a. s.
- Jasterjemskaia, N. & Titov, Y. (1998). Rhythmic gymnastics. Champaign, IL: Human Kinetics.
- Novotná, V., et al. (1983). Celoroční program sportovní přípravy žactva v oddílech MG – Moderní gymnastika. Praha: ÚV ČSTV.
- Perič, T. (2008). Sportovní příprava dětí. Praha: Grada.
- Primary School Curriculum. (2010). Dublin: NCCA. http://www.curriculumonline.ie/en/Primary_School_Curriculum/Physical_Education/PhysicalEducation_Curriculum/First_and_second_classes/Content/
- Rámcový vzdělávací program pro základní vzdělávání. (2013). Praha: MŠMT ČR.
- Rámcový vzdělávací program pro předškolní vzdělávání. (2004). Praha: VÚP v Praze.
- Stafford, I. & Balyi, I. (2005). Coaching for long-term athlete development. Coachwise: sports coach UK.

Süss, V., Matošková, P., Novotná, V., Čechovská, V., Kolčiterová, J. & Kaplan, A. (2008). Kultivace pohybového základu. In Mužik, V., Dobrý, L., Süss, V. (Eds.). Tělesná výchova a sport mládeže v biologickém, psychologickém, sociálním a didaktickém kontextu (119-126). Brno: Katedra tělesné výchovy Pedagogické fakulty MU.

Šimůnková, I., Novotná, V. & Vorálková, J. (2010). Struktura složek pohybové gramotnosti pro sportovní odvětví moderní gymnastika. *Studia Kınanthropologica*, XI, (2). (110-117).

Whitehead, M. (2001). The concept of physical literacy. *PE and Sport Pedagogy. European Journal of Psychical Education*. 6 (2). 127-138.

Whitehead, M. (2010). *Physical literacy: throughout the lifecourse*. London: Routledge.

Whitehead, M., Murdoch, E. (2006). Physical Literacy and Physical Education: Conceptual Mapping. *PE Matters*, 1 (1). 6-9.

Werner, H., P. (2004). *Teaching children gymnastics*. Champaign, IL: Human Kinetics.

Zítko, M., et al. (1985). *Celoroční program sportovní přípravy žactva v oddílech TJ – Sportovní gymnastika*. Praha: ÚV ČSTV.

Zítko, M. & Chrudimský, J. (2006). *Akrobacie*. Praha: ČASPV.

The use of information technology in non-formal education and learning of handball coaches

Eva Urbánková, Tomáš Augustýn, Vladimír Jůva

Faculty of Sports Studies, Masaryk University, Brno, Czech Republic

Abstract

Information and Communication Technology (ICT) plays an important role in the gradation of the coaching profession. Our empirical research targets this area, questions specifically the use of ICT in non-formal education and informal learning coaches handball. Empirical research was to analyze the specific forms and methods of use of information technology (video channels, social networks, electronic databases, websites, computer programs, smart phones, etc.) In non-formal education and informal learning of coaches.

The research had two phases.

In the first phase was used a questionnaire which was then distributed to coaches, coaching various sports. Data were collected from 186 coaches. After quantitative evaluation survey were made case studies (interviews) with three selected coaches of handball. The research showed that ICT trainers commonly used both in personal life and their coaching. In connection with the trainer activity, predominates using one-way communication, especially the study – methodic guidelines. Two-way communication, such as Microsoft Internet e-learning courses, forums, webinars, etc.. using significantly less. Coaches do not use ICT in their direct coaching too often during training or a match, while particularly at the top level usual work on a computer with video.

There were no statistically significant differences between men and women in any of the observed characteristics.

Trainers with international experience reported sophistication of ICT use for coaching profession in other countries (the performance of selected examples from Norway).

Keywords: *Empirical research, sports coach, Information and Communication Technology (ICT), Methodic – study guidelines, one-way communication, two-way communication.*

Acknowledgement

The article was funded by specific research project on FSpS MU No. 51 2120 – “The use of information technology in non-formal learning of sports coaches”.

Introduction

The development of the coaching profession has recently increased attention (eg Jansa & Dovalil 2009; Sekot 2006; Trudel & Gilbert 2006), and in this area was published some results of empirical research (eg Jansa & Smith 2008; Lavallee 2006). Information and Communication Technology (ICT) play an increasingly Important role in the gradation of the coaching profession. Our empirical research targets this area, questions Specifically the use of ICT in non-formal education and informal learning coaches handball. Empirical research was to analyse the specific forms and methods of use of information technology (video channels, social networks, electronic databases, websites, computer programs, smart phones, etc.). In non-formal education and informal learning of coaches.

Methods

The research had two phases, quantitative and qualitative.

In the period from January to July 2013 we carried out a questionnaire survey. We used a questionnaire of our own design and distribute it electronically through persons authorised by mail or personal delivery, in printed form. The aim of the survey was to obtain an overview of selected aspects of the use of information technology in non-formal education and informal learning coaches of different sports.

Overall, 186 questionnaires were returned completed, identified characteristics of the study sample are shown in table 1. Most represented group of respondents consisted of trainers-men (72 %), the average age was 38 years (youngest 18, the oldest 68 years old) and the largest group was 31-45 years (51 %), the majority of coaches (63 %) work in cities over 100,000 inhabitants, more than half of the respondents have completed high school education (51 %), 21 % graduated from high school with a focus on sport. Most respondents (46 %) holds a license B (second class). Most coaches operate semi-professional (37 %), only slightly less voluntarily (35 %) and 28 % professional. Among respondents dominate the head coaches (61 %), 21 % act as assistants, 11 % as a team leader and the rest (9 %) to a different position. Half of them (50 %) work with children or youth, 11 % of adults and 39 % in both age groups. Most coaches focuses both boys and girls (44 %), only 42 % of boys and girls, only 14 %. The respondents are the most represented handball coaches (24 %), basketball (22 %) and soccer (18 %), overall there were 13 sports (Table 1).

Tab. 1 Characteristics of the study sample (in percents, N = 186)

Gendre	Men	72
	Women	28
Age	18-30 years	28
	31-45 years	51
	46-60 years	19
	61 years and more	2
Size of locality covered by coach	The city with over 100 000 citizens	63
	The city from 2 000 to 99 999 citizens	20
	Town to 1 999 citizens	16
The highest level of education	Primary	3
	Secondary	51
	Higher professional education	8
	Higher without sport orientation	18
	Higher education with sports orientation	21
Coaching class	A (I. class)	16
	B (II. class)	46
	C (III. class)	31
	Lower or without license	7
Coaching experience	Professional	28
	Semi - professional	37
	Voluntary	35
Coach position	Head Coach	61
	Coach assistant	18
	Team leader	11
	Other position	9
Trained athletes by age	Children and youth	50
	Adults	11
	Different age category	39

Trained athletes by gender	Only girls / women	14
	As boys / men	42
	Girls / women and boys / men	44
Coaching activities in sport (13 total sports)	Handball	24
	Basketball	22
	Football	18
	Athletics	13
	Fitness	10
	Tennis	8
	7 other sports	5

Interviews were done with three selected coaches in the second phase. Selection of trainers was intentional, was chosen three experienced coaching personalities of handball, which was the most represented sector among respondents. Dušan Poloz – champion of 2012/2013 with a women’s team DHK Banik Most, head coach of women’s representation Slovakia; Jaroslav Hudeček – men’s national coach of the Czech Republic; Jana Hajžmanová – longtime the coach of youth teams HC Banik Karviná (several masters CZE) (addressing coaches agreed to the publication of their names and information provided).

The purpose of these interviews was to clarify opinions and attitudes on selected topics from the first phase.

Results

In the questionnaire survey, coaches commented using various resources through ICT. The most commonly used methodological materials are on their own sports association websites (77 %), foreign sports association websites (48 %) and the video conferencing or webinars (10 %) and paid internet sources (5 %) (Table 2).

Tab. 2 The use of different sources (in percent)

	YES	NO
Methodical materials on the website of the Czech association	77	17
Methodical materials on the website of foreign sports association	48	44
Methodical materials on the website of a European federation	37	54
Methodical materials on the website of the World federation	25	61
E-learning courses	13	73
Video conferencing or webinar	10	73
Pay online resources	5	79

Coaches mentioned that they use international resources during their work, the most used is English (56 % of respondents use CD and DVD in the English language and 52 % internet materials), followed by Slovak, and German. The use of foreign sources is shown in Table 3.

Tab. 3 Use of foreign sources (in percent)

	English	Slovak	German	Polish	Hungarian	Spanish	French	Russian	Slovenian	Serbian	Italian	Norwegian
CD a DVD	105	60	51	3	3	3	2	1	1	1	1	0
Internet resources	98	61	38	8	3	3	1	2	1	1	1	2

Offer methodological CD and DVD in the Czech language evaluated positively 49 % of the respondents, 39 % negatively, failed to express 11 %. The same, but in foreign languages positively at 47 %, 25 % negatively and failed to express 23 %. In both cases, therefore prevails a positive evaluation.

In common coaching practice is the most widely used means of ICT computer, both overall and in each activity separately. Detailed overview of the data is in table 4. In preparation for the training unit it uses 68 % of coaches and 53 % in preparation for the game / race, 46 % in the evaluation of training units, 41 % in the evaluation of the game / event. Not inconsiderable are used tablets and mobile phones (is shown in Table 4).

Tab. 4 Use of ICT in the work of trainers (in percent)

	PC	The Tablet	Mobile phone
In preparation for the training unit	68	13	12
During training unit	12	6	10
When evaluating training unit	46	10	3
In preparation for the game / race	52	7	10
During the match / race	14	5	1
When evaluating the match / race	22	10	9

In other parts of coaching job (notes during a training session, match/race communication device using the audio with another person in the stands), was not relevant using of ICT, with the exception of the evaluation of the game / race (ICT uses 63 %, the most used is the table processor, which uses 46 % of the total amount) and leadership training diary (in electronic form it is 38 %, the most used type of program is a spreadsheet that uses 25 % of the total amount).

Part of the trainers are active debaters via the Internet. With the public regularly discussed this form of matches 15 % of coaches. At least occasionally use the internet more than half of the trainers for discussion with other coaches about the concept of their training (54 %), discussion with the public about their training sessions (61 %), discussion on matches with other coaches (61 %), with only a discussion of his players training sessions and matches, less than half of the respondents (41 %). 56 % of trainers use Facebook, other social networks are hardly used.

Discussion

The results of the questionnaire survey showed the characteristics of the selected use of ICT in non-formal education and informal learning. The most frequently used source are materials of the sports association websites, paid at least used resources, webinars and video conferencing. This certainly corresponds with that is just wide of the materials placed on the websites, while paid minimum resource exists a webinar or video conferencing are still too often offered in the form of education. Selected three coaches with whom interviews were conducted with the use of different sources, but both emphasise the significant influence of other coaches (especially division colleagues and coaches of national teams) for their professional development.

In preparation for the training unit uses the computer 68 % of respondents. In interviews with three selected coaches were preparation for the training unit widely discussed and all three of them prepare the training manual writing by hand and generally use a variety of materials, including methodological CD and DVD or Internet resources. It can be assumed that most of the 68 % above coaches will do that similarly.

Interesting data, among other, the use of computers in the game (says 22 % of respondents). Of the three selected coaches, none of them mention the use of computers in the match.

There is not widespread use of tablets that are easier to handle and could be used also in practice, for example as the Dušan Poloz, who spoke about the coach in Norway, which showed the players a training exercise on the tablet just before the training started. It also gives other examples of the sophistication of ICT use in Norway (eg keeping a training diary by players of broader national selections in intranet; services for editing videos from the game, an extensive range of methodological materials, etc.).

We can also expect being progressively more used mobile phones that have a high computing performance and lots of features, such as camera, the ability to work with video yet, but there is still no suitable applications to enable their wider use.

The data shows that trainers are able to discuss the issue of their coaching practise. Interestingly, at least discuss with their own players. Dušan Poloz argue that a deeper discussion on these topics with players is necessary made like oral interview.

Conclusions

The results of the empirical investigation showed the characteristics of the selected use of information technology by sports coaches. Considering the size of the Sample (186 respondents) the presented results can not be generalised in all coaching area. Different types (13) of sports trainers took part in the research, each of which has its own specifics, including sports, whose representatives did not participate in the research.

When compared to regular communication with others (most coaches regularly discuss with the public matches, 15 % of trainers), which is two-way communication, with unidirectional pumping data over the Internet (only methodological materials on the website of the Czech sport association of their sport uses 77 % of the trainers) we can conclude that one-way communication outweighs the double. This is confirmed by the low use of E-learning (13 % of trainers) webinars and video conferences (stated 10 % trainers), which also includes the two-way communication. On the contrary, there were no statistically significant differences in the use of ICT between men and women.

References

- Jansa, P., Kocourek, J., & Kovář, K. (2009). Fundamentals of Sport Pedagogy. In P. Jansa & J. Dovalil. (Ed.), Sports training: Selected kinanthropology to promote active lifestyles (s. 38-71). Praha: Q-art.
- Jansa, P., & Kovář, K. (2008). Opinions and attitudes of coaches in some sports. In the current sports training (s. 317-321). Praha: UK.
- Lavallee, D. (2006). Career Awareness, Career Planning, and Career Transition Needs Among Sports Coaches. *Journal of Career Development*, 33(1), 66-79.
- Sekot, A. (2006). The social aspects of professional position coach. In Sport as a socio-cultural phenomenon (s. 13-30). Brno: Masaryk Univerzity.
- Trudel, P., & Gilbert, W. (2006). Coaching and Coach Education. In D. Kirk, D. MacDonald, M. O'Sullivan (Eds.). *The Handbook of Physical Education* (s. 516-39). London ad.: SAGE.

Methodical Materials for Elimination of Language Barriers in Sports Environment: Sports Terminology

*Renáta Východilová, Věra Večeřová, Zora Svobodová, Radka Strěštíková
Faculty of Sports Studies, Masaryk University, Brno, Czech Republic*

Abstract

Learning languages is a vital part of today's life. Especially in small countries, where the whole infrastructure depends on the ability to communicate in other languages than in their mother tongues only, the knowledge of foreign languages increases the possibilities to assert in almost every working field. The objective of the paper is to introduce the project whose goal is to provide a secondary school education material which can extend the foreign language learning process in selected sports.

Keywords: *Language learning/teaching process, interactive multimedia educational material, secondary school instruction, sports terminology.*

Introduction

“How many languages you know, so many times you are a human being” says one of the Czech proverbs. The foreign language learning is a mandatory part of the basic elementary school education. Secondary and tertiary educations are then based on this knowledge and extend it. The goal of this paper is to present the project whose output is called “Sports Terminology” and whose aim is to enhance the foreign language learning and teaching process in secondary schools with sports specialization and to contribute to the enrichment of both the students' vocabulary and their ability to communicate fluently and assertively in a specific sports environment. This can improve the students' competitiveness and their capability of the professional fulfilment within the European Union setting. A lot of sources focused on sports terminology can be found either online or in published form. The project aim is to assort the basics of particular, selected sports and to introduce them in English and German language to students in an attractive, modern, interesting and entertaining as well as illustrating way.

Methods

Based on the basic principles valid for the creation of textbooks and other materials designated for the foreign language learning process, on the expert knowledge, on the contribution and participation of PE teachers, translators, supervisors and other experts, an e-learning material for the foreign language learning process was created.

The output of the project is an interactive multimedia educational material designated for the secondary school foreign language learning/teaching process. In the course of the project duration 4000 secondary school students will get involved in the introduction of the project material and 200 secondary school teachers will participate in it. The basic intention of the project is to enable to use this educational material in the school instruction, namely in the foreign language learning process in secondary schools with the extended sports education primarily. It can be used in the foreign language learning process in any secondary school, however. The material can function as a form of self-study at home too, and it can be checked in the foreign language learning instruction later on. Another possibility how to utilise the material is to let students who cannot temporarily participate in the PE instruction actively complete it during PE lessons.

The most important and most frequently used specialized sports vocabularies of 13 selected sports are included in this educational material. The most frequent and favourite sports taught in Czech secondary schools with sports specialization were taken into consideration when the sports were selected for the project material. On the basis of this survey the project material is divided into 12 chapters in which 13 following sports are introduced: football, tennis, volleyball, floorball, basketball, handball, cross-country skiing and biathlon, swimming, judo, down-hill skiing and snowboarding and athletics (Fig. 1).

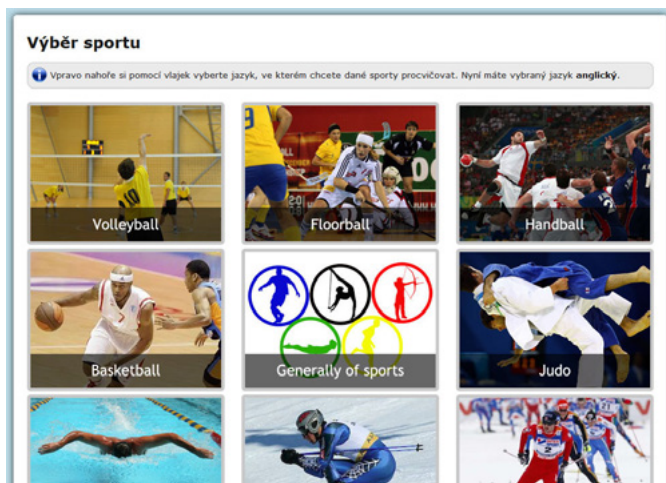


Fig. 1 Introductory Page

One of the chapters called “Generally of Sports” is dedicated to more general sports issues. One of its parts pursues the general knowledge of the human muscle system and its functioning. Another one involves the basics of sports nomenclature used in all sports. Other parts of this chapter introduce the issues of the Czech sports history, as well as the greatest Czech sports successes in the Olympic Games and different championships (Fig. 2).



HISTORY OF THE OLYMPIC GAMES

Read the following statements. In pairs, discuss whether they are true or false.


1) The ancient Olympic Games were always held from mid-August to mid-September.	<input type="radio"/> True <input type="radio"/> False
2) Winners of individual disciplines were awarded with an olive wreath.	<input type="radio"/> True <input type="radio"/> False
3) The first modern Olympics were held in 1896 in Paris.	<input type="radio"/> True <input type="radio"/> False
4) The International Olympic Committee is based in Lausanne, Switzerland.	<input type="radio"/> True <input type="radio"/> False
5) The Olympic flag consists of six interlocking rings.	<input type="radio"/> True <input type="radio"/> False
6) The Olympic flame was transferred for the first time from ancient Mount Olympus in 1928 to the Olympic Games in Amsterdam.	<input type="radio"/> True <input type="radio"/> False

Check

Fig. 2 Chapter Called Generally of Sports

Each chapter was written by an expert of the particular sport in the Czech language first. This Czech version was then checked by an opponent, another expert in this sport and the material was subsequently translated into a foreign language. As English is a foreign language of the prominent importance and the German environment surrounds our home country, these 2 languages were chosen for the project (Fig. 3). The translation was realized by native speakers, sportspeople acquainted with sports environment closely. The translation process ran in the cooperation with English and German language teachers and PE teachers concurrently. The teachers to whom this e-learning material is introduced in seminars and workshops and who use and test it in the school instruction will also get involved in the process of creation. Their expert observations and comments will be incorporated into the material after they get familiar with it, use it in their lessons and get a feedback from their students.

Home O projektu **Sporty** Fotogalerie Kontakty Autoři

 Tester Tester 8.A [Odhlásit se](#)

Výběr sportu

i Vpravo nahoře si pomoci vláček vyberte jazyk, ve kterém chcete dané sporty procvičovat. Nyní máte vybraný jazyk **anglický**.

Fig. 3 Language Choice

As the language learning/teaching methodology process is concerned, each chapter of the project material starts with easier, generally known vocabulary (Fig. 4). Next, more specific terms are gradually introduced, involving the historical development of particular sport as well as its essential facilities and equipment. Further, individual skills and techniques, their training and mastering are analysed (Fig. 5), followed by the introduction of the basic rules (Fig. 6). Game combinations and formations of particular sport are placed at the end of the chapter in each sport (Fig. 7).

i Introduction

i Match the words to the corresponding definitions.

THE GOAL AREA REFEREES PASSING A HALF RULES A THROW-OFF DRIBBLING A DEFENDER DISQUALIFICATION
HANDBALL PLAYERS

- i** 1) They are two people with clothes which differ from those of the players who are on the court and intervene in the game when there are rule violations.
- i** 2) It refers to one part of the playing time. In handball, the total playing time is divided into two such parts.
- i** 3) It is the part of the court in front of the goal delineated with a 6-metre line with special rules for players.
- i** 4) It is when the ball is bounced on the ground allowing the player with the ball to move.
- i** 5) This is the start of the game from the middle of the centre line at the beginning of the half-periods or after a goal has been scored.

Fig. 4 Introduction

🔊 Spielhandlungen des Einzelspielers

🔊 Hör zu und wähle für die einzelnen Spielhandlungen den richtigen Begriff aus.

Korbwurf Pass Dribbling

🔊 Es ist eine Spielhandlung des Einzelspielers, durch die er sich dem Angriffsspiel mit der Absicht anschließt, den Ball in den gegnerischen Korb zu befördern. Der Spieler nimmt den Ball an und spielt ihn an den nächststehenden freien Mitspieler oder an den Spieler, der in der besten Position für einen Korbwurf ist, weiter. Dies kann der Spieler so ausführen, indem er den Ball rollt oder auf den Boden tippt. Er wirft den Ball aus der Höhe der Taille, der Brust oder über dem Kopf ab.

✔ Überprüfen

Fig. 5 Skills and Techniques

🔊 Grundregeln

🔊 Konstruiere die Regeln.

AUSSTATTUNG UND AUSTRÜSTUNG

Das Spielfeld ist ein Rechteck von 28 x 15 Metern, es muss eine ebene, harte Oberfläche haben und frei von allen Hindernissen sein. Die Höhe der Decke
Der Drei-Punkte-Bereich einer Mannschaft, aus dem es möglich ist, beim Korbwurf drei Punkte zu erzielen,
Das Spielbrett muss aus einem durchsichtigen Material oder aus hartem Holz bestehen. Die Höhe des Spielbretts beträgt 1,05 m und die Breite 1,80 m,
Die begrenzten Zonen sind auf dem Spielfeld zu markierende Flächen, die jeweils durch die Grundlinie,
Der Ball ist rund, hat einen Umfang von 74 cm – 78 cm,

1.
muss mindestens 7 Meter betragen, die Begrenzungslinien – Grundlinien und Seitenlinien – sollen mindestens 2 Meter von allen Hindernissen entfernt sein.
2.
ist 6,25 m von dem Punkt entfernt, der sich direkt unter dem Mittelpunkt des Korbringes auf dem Boden befindet. Er besteht aus der gesamten Spielfläche hinter der Drei-Punkte-Linie.
3.
und sein Gewicht beträgt 567 – 650 g.
4.
die Freiwurflinie sowie durch zwei Linien begrenzt sind, die von der Grundlinie ausgehen und am äußeren Rand der Freiwurflinie enden.
5.
die Unterkante befindet sich 2,90 m über dem Boden. Der Korb besteht aus einem Ring und einem Netz. Die Oberkante des Rings liegt auf einer Höhe von 3,05 m über der Spielfeldoberfläche.

✔ Überprüfen

Fig. 6 Game Rules

Formations

Complete the text with the sports expressions used in the previous exercises.

Volleyball is a game of constant motion in which you cannot 1) h*** the ball. The volleyball techniques of serving, passing, setting, spiking, blocking, and digging are the six major volleyball 2) s***** players must develop to be able to play volleyball. At the advanced and elite levels volleyball teams have specialized players who play a specific role in a volleyball match, for example setters, hitters, blockers. There is one more 3) p***** named libero. These specialized positions play a key role in the game formations. There are four standard volleyball formations, known as "0-6", "4-2", "6-2" and "5-1". The numbers refer to the number of hitters and setters respectively. The 0-6 formation is the easiest one. It is practised with volleyball beginners and young volleyball teams, or with the teams at the lower levels, where there are not very experienced or 4) s***** players. In young volleyball teams the formation focuses on the preparation of all-round volleyball players in all the positions on the court. Each player standing in the middle front position becomes a setter and the other front-row players are hitters. The front-row setter usually stands in the middle position between two hitters. To strengthen the team's 5) d***** the setter can also set from the right front position and the right front player moves to the middle position to help to block the opponent's attack.

Fig. 7 Game Formations

To enable to check and assess the students' improvement by teachers, at the end of each chapter a final test is placed in each sport (Fig. 8). Thanks to this test, everybody can learn how much of the new vocabulary they acquired by completing the whole chapter dedicated to the particular sport. To enliven and enrich the learning process and to make it more comprehensible and clearer, the illustrative videos as well as photos are used for some of the exercise types.

Final Test

Do you know the correct answer? Who will get the most points? Each correct answer is 1 point.

1) What shape is the contest area in Judo?

- a) A square
- b) A circle
- c) A triangle

2) In Judo, immobilisation techniques are categorised into three groups. The first is holds, the second is armlocks, and the third is ...

- a) Twists
- b) Tightening
- c) Chokeholds

Fig. 8 Final Test

The principles of foreign language learning process and the methodology of teaching foreign languages are closely taken into consideration. To meet the general requirements of the creation of textbooks designated to foreign language learning process, the project material focuses on practising of all main language learning skills: speaking, reading, listening and writing (Fig. s 9-10). The educational material

tries to balance their use so that none of them is given any considerable preference. The project material works with standard types of exercises used in foreign language learning/teaching process. Thanks to the possibility to employ illustrative videos and photos, it brings easier and better comprehension, understanding and clearness into the learning process and subsequently more significant benefit to students.

🔊 **Einführung**

🔊 **Lies den Text und ergänze die Begriffe aus Übung 1.**

Floorball ist eine Mannschaftssportart mit dem Charakter eines Ball- und Torspiels, die an Hallen-1) Helm erinnert. Das Prinzip des Spiels besteht im Kampf zweier Mannschaften mit jeweils sechs Spielern. Es geht darum, in der Spielzeit eine größere Anzahl an Toren als der Gegner zu schießen. Die fünf Feldspieler verfügen über spezielle Schläger, der Torwart hat keinen Schläger. Es wird in einer Halle mit ebener und glatter Oberfläche gespielt, die die Bewegung der Torwarte und der Schlägerschaufeln ermöglicht. Die Einhaltung der Regeln überwachen zwei gleichberechtigte Schiedsrichter. Das Spielfeld ist von einer 2) mit abgerundeten Ecken begrenzt und durch die Mittellinie in zwei Hälften geteilt. In der Mitte des Spielfeldes befindet sich ein Mittelpunkt, auf dem das Bully ausgeführt wird. In jeder Hälfte befindet sich ein 3), das ähnlich wie beim Eishockey im Feld aufgestellt wird, so dass das Spiel hinter dem Tor möglich ist. Um jedes Tor herum sind zwei rechteckige Räume (Torraum und

Fig. 9 Reading

🔊 **Introduction**

🔊 **Listen and answer the following questions.**



Back Continue

Fig. 10 Listening with Illustrative Video

Results, discussion and conclusions

Concerning the foreign language learning process, we tried to extend and deepen it in the sports field. The foreign language learning is doubtlessly considered an important and essential part of the secondary school education and contributes to students' chances to assert oneself in the labour market. The material offers a specific extension of the foreign language learning process, but can also function as an example of the cooperation in two or more school subjects in the school instruction. In the project material, the IT, PE and foreign language classes are integrated.

To conclude, we can state that in spite of the fact that the project is still in progress and we have got the running outputs from the pilot verification only, the results we have received so far show that students who have already participated in the project have made progress. The material has been tested by students in 3 selected pilot secondary schools. The students chose a sport first. They filled in the final test of this sport then. Further, they completed all the exercises of all the chapters of the particular sport and answered the final test again. The obtained data and results show that by going through a particular sport, students gain a higher percentage in the final test when completing it again at the end of the learning process, which provides them with a wide knowledge of a particular sport vocabulary. Therefore we can state that the test results show students' improvement.

References

Fronek, J.: Velký česko-anglický a anglicko-český slovník. Voznice: Leda, 2006.

Heřmanský, J.: Moderní anglicko-český slovník sportovních výrazů. Brno: Barrister & Principal, 2003.

Langenscheidts Großwörterbuch Deutsch Als Fremdsprache. Langenscheidt, 2006.

QUANTITATIVE AND QUALITATIVE ANALYSIS OF HUMAN MOVEMENT

The analysis of one-handed overhead throwing

Vladimír Süß, Petra Pravečková, Bronislav Kračmar, Petra Matošková

Faculty of Physical Education and Sport, Charles University in Prague, Czech Republic

Abstract

The one-handed overhead throwing is one of the skills that are phylogenetic ally very old. Kinematic analysis of throws point to a certain similarity in their execution. The aim of this paper is to show the intra-individual differences in involvement of selected muscles during the performance of different types of one-handed overhead throwing. It is a case study based on intra-individual description using electromyographic analysis. Reference person was twenty-two man, playing extra league in baseball.. The basic method of describe was analysis graphs of the electric potential, which was sensed by EMG apparatus „ME 6000“. Surface electromyography shows the differences in the electrical activity of the muscles of the shoulder girdle, not just in phases of throw that precede the power phase of the throw, but also during the actual swing of arms during and after drop the ball. In practice, it is useful to know the differences in the performance of different types of throws to avoid unnecessary overloading of the shoulder joint of players in training. For specific person it can be recommended to not to use certain types of throws in practice, to avoid disruption technique of baseball pitches.

Keywords: *Electromyography, baseball, one-handed overhead throwing, analysis skills.*

Acknowledgements

The project was supported by Czech Republic's Ministry of Education, Youth and Physical Education MSM 0021620864 and program PRVOUK no. 38.

Background

The throwing by different subjects is one of the skills that are phylogenetically very old. Since the initial purpose of skills used to fight and hunt it is currently targeted in their execution for a sporting activity. The modifications include the javelin, various versions of sports games type of pass or shoot on goal in handball, pass of quarterback in American football, passes in the basketball, pass or pitch in softball and baseball. Also the skills as service or smash in volleyball are classified in this group. A common feature is the dynamic movement and efforts to give the kinetic energy to a light object (a ball, javelin...), aim to give it the highest speed in a certain direction and transport it with great precision. In many cases, it is a combination of both principles.

The classifications of throws are not usually very different (Véle, 2006; Süs, 2006). The skills are divided according to the position and direction of movement of the arm. There are overhead throwing, sidearm and underarm throwing. Kreighbaum, and Barthels (1900) added the kicks to the ball to this classification.

One-handed overhead throwing

The skill is the subject of many studies. Description based on kinematic analysis and the authors describe throwing by the critical points and movement phases. Throw is divided into three phases by Pappas et al. (1985), into four by Xue and Masuda (1997), into five by Andrews and Wilk (1994); Braatz and Gogia (1987) and Walsh (1989), but normally the throw is separated into six phases such for example by Dillman et al. (1996), and Fleisig Escamilla (1996), Werner et al. (2002), Zheng et al. (1999). In the case of baseball pitch Fleisig and Escamilla (1996) define 7 critical points that surround the 6 phases of movement. They are 1) the initiation of pitch, 2) the maximum height of the knee during step forward 3) contact of step forward legs to the ground, 4) maximum external rotation of the shoulder joint during backswing, 5) the time of launch balls, 6) maximum internal rotation after the launch of the ball, 7) completion of the movement.

In our study we compared different types of throws. We come out from the distribution with the following modifications. Given that we compared several throws where no significant change in the horizontal movement of the knee when stepping out, we have reduced the number of critical points of the said point and we did not include the 6th critical point. Given the uncertainties beginning of movement, and thus a large time differences in the first phase, we decided to include the 2nd critical point, which is the time of initiation of movement of the left leg, at a time when the heel of the left foot lifts from the pad. In the description we use the 6 critical points and we get the 5 phases of movement.

We have defined *the first critical point* as the beginning of the throw, which will calm down the basic attitudes. *The second critical point* is the time when the left leg starts to move, at a time when the heel of the left foot lifts from the pad. *The third critical point* is the moment when the step forward leg contacts the ground by the whole foot. *The fourth critical point* is defined as the point of maximum backswing of maximum external rotation in the right shoulder joint (hand and wrist with a ball point to the opposite direction of the throw). The time of launch balls is defined as *the fifth critical point*. *The sixth critical point* is characterized by the completion of the movement of throwing arm in the direction diagonally down in front of body.

Kinematic analysis of these throws point to a certain similarity in their performance. The aim of this paper is to show the intra-individual differences in the involvement of the selected muscles during the performance of different types of one-handed overhead throwing.

Methods

It is a case study based on intra-individual description using electromyographic analysis. Reference person was man twenty-two years old, playing Extra league in baseball.

The methods used

1. Kinematic Analysis – To define the critical points during the throws, we used a 2D kinematic analysis. This was done by analyzing the video using the Dartfish software. The video was recorded at a frequency of 25Hz. Decomposing the fields using “Dartfish” the final frequency for 2D kinematic analysis was adjusted to 50Hz.

2. Electromyographic recording – The basic methods to describe muscle involvement were chosen surface electromyography. Electromyographic recording was recorded using EMG apparatus ME 6000 with record frequency of 200 Hz. Selection of monitored muscles was based on expert evaluation. The monitored variables were the muscles of the shoulder girdle on his right arm. Electrodes were glued to the muscles on the recommendation of Travell & Simons (1999). To determine the description of the electrical activity of muscles we synchronized EMG recording with video.

Results and Discussion

The rhythm of movement. Using kinematic analysis, we determined the distribution of the critical points monitored during different types of throws. This distribution shows, that the person, being performed movements, has a relatively steady rhythm (Table 1). Designation of critical points is in compliance with defined critical points at the outset. Data are presented in a standardized time scale using per cent.

Tab. 1 Critical Points

Critical points (CP)	1 CP	2 CP	3 CP	4 CP	5 CP	6 CP
Normal throw	0	27	64	70	80	100
Throw without left arm	0	29	64	72	82	100
Front throw	0	18		61	78	100
Baseball pitch	0	16	72	75	83	100

The kinesiological analysis of the normal throw (Fig. 1), of the throw from frontal position, of the throw without the involvement of the contralateral upper limb and of the baseball pitch.

At the first measurement of muscle *musculus gastrocnemius sinister (m.gastr. sin), caput medialis et lateralis*, ie on the contralateral side of the upper limbs, which

throws, co-contraction of both heads of the muscle is a very interesting during normal throw, manifesting but only before 2nd critical point of motion, ie when the heel of the left leg begins to lift off the pad. Followed by a higher activation of the inner head to be subsequently moved to the dominance of the inner head. The external head starts rotating the whole body and then the inner head inside takes dominance to lift the trunk to drop. Activation of muscle *musculus rectus femoris sinister (m.rect.fem.sin)*, logically starts after the 4th critical point, ie after the extension of the muscle, after phase 4, after the maximum backswing and maximum external rotation of the shoulder joint. The local maximum of muscle *musculus obliquus abdominis externus dexter (m.obl.abd.ext.dx)* prevents the activation of this muscle, just before the 4th critical point. *Musculus obliquus abdominis externus dexter (m.obl.abd.ext.dx)* as crucial muscle for torsion of trunk otherwise shares the common onset of decisive muscle activation in 62 % of the reference cycle with *m.rect.fem.sin*, but initiates the torsional movement of the trunk to the left by overtake of the local maximum. Local maximum of muscle activation *musculus pectoralis major dexter (m.pect.maj.dx)* in 4th critical point coincides exactly with the local maximum contralateral muscle *musculus pectoralis major sinister (m.pect.maj.sin)* at 70 % of time. Left-hand muscle is activated but still in the preparatory stages of the throw, which prepares effect on the contralateral upper limb torsion torso to the left, ie in the sense of power to release the ball. Common local maximum then objectifies the correct execution of the throw in terms of torsion of the trunk during normal throw. *Musculus deltoideus dexter, pars scapularis (m.delt.dx.p.scap.)*, thus the rear portion of the muscle EMG exceeds the area under the curve (approximate characteristic cast of muscle work) in the region of 30 %-60 % (during step with contralateral lower limb) area under the curve of EMG muscle deltoid *musculus dexter, pars clavicularis (m.delt.dx.p.clav.)*, ie the front part. This fixes the shoulder joint at the stage of maximum flexion and external rotation, while *m.delt.p.scap.*, the front of the muscle leads back of the ball at the moment of release, then to the back of the muscle fixed the shoulder joint against excessive internal rotation of the larger area under the EMG curve. For *musculus trapezius muscles dexter (m.trap.dx)* et *musculus trapezius sinister (m.trap.sin)* have similar characteristics as their interaction with muscle *m.pect.maj.dx* et *m.pect.maj.sin*. Comparison of muscle activation *musculus triceps brachii, dexter, caput longum (m.tric.br.dx)* and *musculus biceps brachii, dexter, caput longum (m.bic.br.dx)* shows a close temporal correlation in terms of extensor versus flexor (in the observed throw of 79 % versus 82 %). With only very close to the 3 % distance local maxima extensor and flexor muscles of the elbow cannot talk about as long co-contraction heads arm muscles, which in turn are described in loco motor function of the shoulder girdle (Vojta a Peters, 1995; Vystrčilová Kračmar, Novotný, 2006). At the 5th critical point can be traced to local maxima timing and area under

the EMG curve in order m.tric.br.dx m.bic.br.dx.. Activation of the elbow flexor, which follows the activation of extensor flex the elbow begins after release his ball, that is 5th critical point. Comparison the areas under the EMG curve clearly shows the reciprocal innervation, the area under the curve extensor EMG gradually gives way to the area under the flexor surface EMG. Overlapping both areas confirmed the situation of mutual control function antagonists (Veľe, 2006).

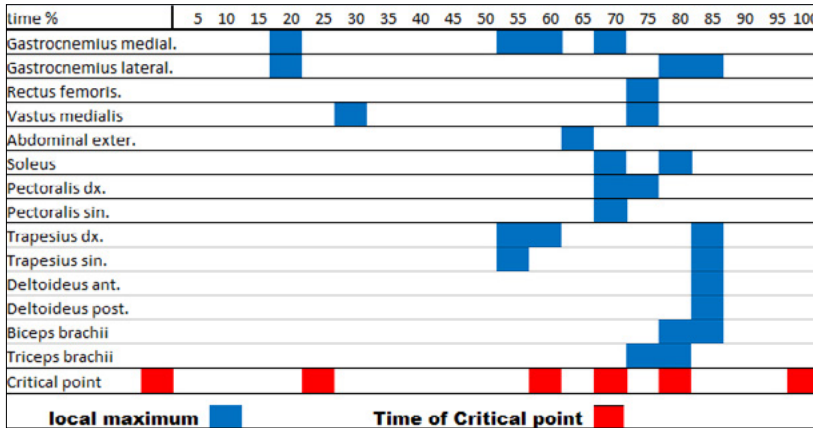


Fig. 1 Analysis of the normal throw – local maximum of muscles

Differences in muscle involvement in various types of throws

By the automatic measurement of the analysis of EMG data *m.obl.abd.ext.dx* reports the different height of the amplitude of the local maximum in the individual throws. The normal throw from diagonal position – 250 μ V, the front throw – 160 μ V, the throw without left arm – 200 μ V, baseball pitch – 600 μ V. Because of the measurements were carried out without relabelling electrodes, from these values we can deduce, what conditions this muscle should have for the implementation of its function of the torsion of the trunk in the direction of the throw. Logically, the conditions were violated during the front throw when the possibility of the diagonal concatenation of the muscle functions going on from the right side of the trunk just over *m.obl.abd.ext.dx* on the contralateral side through the thigh muscles of the left leg to the fibula is artificially limited. The limitation of torsion trunk by the position of the left leg also reduces the possibility of the involvement of the muscle in terms of functional concatenation. During the baseball pitch a local maximum scrolls between critical points 4 and 5 (between the maximum backswing and the launch balls) up to 80% of

the reference section, it is more defined and clearly single peak. During a normal throw the local maximum of the muscle *m.obl.abd.ext.dx* is not clearly defined and located between the critical points 3 and 4 (between the step forward of the left leg on the whole foot and the maximum backswing) at position 68% of the reference section. Timing and height of amplitude with relative minimizing of the area under the EMG curve (greater economy of movement) indicates that the baseball pitch is the basic motion stereotype of the throw of the reference person.

The muscle *m.gastr.sin, caput medialis et lateralis* was found in the mutual differentiating of the muscle function except throw from the frontal position, where there is a co-contraction between the 4th and the 5th critical point (between maximum backswing and the launch balls) and of course there misses local maximum, which is located at the other throws around the 2nd critical point (the heel of the left leg is lifted off the pad), because this critical point in the throw from the frontal position is missing.

The muscle involvement of *m.rect.fem.sin* shows the absence of the significant activation in the throw without involvement of the contralateral upper limbs. This exclusion of flexor lumbar spine demonstrates a gross interference in the motion stereotype of throw. An interesting phenomenon is the fact that in normal throw the timing between local maximum of *m.rect.fem.sin* and *m.obl.abd.ext.dx* is 73 % vs 68 % of the reference section, while in baseball pitch is 73 % versus 79 % of the reference section, ie. inverse timing. This stems from the fact that for the reference person, baseball player, the basic motion stereotype is a baseball pitch, as already stated above.

Kinesiology conclusion

The described phenomenon in the work of the selected muscles and the selected linkages confirm that throw from the frontal position and the throw excluding the work of the contralateral upper limb significantly reduce the concatenation of the muscle function and are examples of bad design of techniques throw. It also negatively affect the common function of the muscles affecting the torsion of the trunk on the ventral and dorsal side of the trunk. The EMG recording also confirmed that the basic motion stereotype of the observed person is a baseball pitch and not the normal throw.

References

- Andrews, JR., Wilk, KE. The athlete's shoulder. Churchill: Livingstone, 1994.
- Braatz, JH., Gogia, PP. The mechanics of pitching. Journal of Orthopaedic and Sports Physical Therapy 1987, 9, p. 56-69.
- Dillman, CJ., Fleisig, G., Andrews, J. Mechanics of throwing. Churchill: Livingstone, New York. 1996.
- Fleisig, GS., Escamilla, RF. Biomechanics of the elbow in the throwing athlete. Operative Techniques in Sports Medicine 4, 1996, p. 62-68.
- Kračmar B., Vystrčilová, M. Nové pohledy na pohybové aktivity člověka – II. Přirozený pohyb člověka. Těl. Vých. Sport. Mlád., 73, 2007, 4, p. 2-8.
- Kreighbaum, E., Barthels, KM. (1990) Biomechanics: a qualitative approach for studying human movement. 3rd ed., New York: Macmillan, p. 749.
- Pappas, AM, Zawacki, RM, Sullivan, TJ. Biomechanics of baseball pitching: a preliminary report. Am J Sports Med. 13, 1985; 4. p. 216-222.
- Süss, V. Význam indikátorů herního výkonu pro řízení tréninkového procesu. Vědecká monografie. Praha: Karolinum 2006, p. 173 s.
- Véle, F. Kineziologie. 2. vyd. Praha: Triton, 2006, p. 375.
- Vojta, V., Peters, A. Vojtův princip. Praha: Grada, 1995.
- Vystrčilová, M., Kračmar, B., Novotný, P. Ramenní pletenec v režimu kvadrupedální lokomoce. Rehabil. fyz. lék., 13, 2006, 2, p. 92-98.
- Walsh, D. Shoulder evaluation of the throwing athlete. Sports Medicine Update 4, 1989, p. 24-27.
- Werner, SL., Murray, TA., Hawkins, RJ., Gill, TJ. Relationship between throwing mechanics and elbow valgus in professional baseball pitchers. Journal of Shoulder & Elbow Surgery 11, 2002, p. 151-155.

Xue, Q., Masuda, K. A biomechanical study of fast throwing movements of the shoulder in baseball pitching. *Chinese Medical Journal* 110, 1997, p. 220-224.

Zheng, N., Fleisig, G., Andrews, J. Biomechanics and injuries of the shoulder during throwing. *Athletic Therapy Today* 1999, 4, p. 6-10.

Treadmill walking and overground walking – the comparison of selected characteristics

Pavel Korvas, Tomáš Kalina, Radek Musil

Faculty of Sports Studies, Masaryk University, Brno, Czech Republic

Abstract

This pilot study deals with the comparison of the basic kinetic and time variables of walk on treadmill and on overground. Three persons were investigated. Vertical plantar forces (VGF) and time characteristics were measured by the Pedar Mobile System (Novel GmbH, Munich, Germany). Probands made natural individual walk on flat and uphill land (9%) at speed 3, 4 and 5 km/hour. For the laboratory research the treadmill Lode Katana Sport 30 (Groningen, NED) was used. For the overground research was used a pavement in the vicinity of the faculty. The speed during field research was checked with the help of cyclocomputer. Seven representative force and time parameters was selected: F_1 – maximal vertical plantar force during absorption stage of stance (LR, MSt), F_2 – the lowest vertical plantar force between both peaks, F_3 – maximal vertical plantar force during propulsive stage of stance (TSt, PSw), F_m – average vertical plantar force for whole stance, t – total time of stance, t_1 – time of absorption stage of stance, t_2 – time of propulsive stage of stance. The probands walked for 15 sec and the last 10 sec was recorded. We evaluated three successive stances of left and right legs. Basic descriptive statistics was used (Mean, SD, percentage) and Effect of Size (Cohen d coefficient). For kinetic parameters (F_1 , F_2) were found out the tendency of increasing values in concordance of increasing speed of walk in the both tests conditions and for F_3 was found the tendency of decreasing VGF for all the probands. For each of these parameters was found nearly all differences among field and laboratory significant. The values of F_3 were always bigger in field and also values for F_1 of two probands. F_m showed insignificant increase of VGR with increasing speeds for both conditions. The time of stance was reduced with increasing speed of walk in both environments. The differences of stances time between overground and treadmill tests were mostly significant. The shorter time of stance with increasing velocity of walk was caused on the first place of propulsive stage time reduction.

The pilot research indicated probable kinetic and time differences between overground and treadmill walk and it shows the needs of follow-up survey of this topic.

Keywords: walk, pavement, treadmill, vertical ground reaction, stance, time.

Introduction

The article focuses on the value comparison of selected kinetic and time parameters of treadmill and overground walking. The treadmill is very often used in the locomotion research, for it offers well controlled and appropriate environment for testing; moreover, it is a simpler research option contrary to overground walking. Whether all the characteristics are consistent with overground gait have been in the past a subject to a number of comparative kinematic studies, EMG, less frequently on the part of kinetics (Elliott 1976; Frishberg 1983; Kobylarz 1990; Lafortune 1994; Nelson 1972; Nigg 1995). From kinematic point of view, small differences in movement patterns have been ascertained (Belli 2001; Dierick 2004; Elliott 1976; Murray 1983; Nelson 1972; Strathy 1983; White 1998); bigger differences have been discovered at older people (Wass 2005). Van Ingen Schenau analytically proved that as long as the treadmill operates at a constant velocity level and the analysis coordinate system moves with the belt, kinetics of overground and treadmill walking are identical. Also Okada (2002) comparing locomotion in treadmill and overground walking at 28 healthy subjects discovered high similarity of motion on both types of research devices. Similarly, Owings and Grabiner (2004) accepted walking on a treadmill as representative for overground walking. However, Strathy (1983) showed some differences between treadmill walking and overground walking (e.g., a longer stance phase of fingers than heels, higher frequency of overground walk to keep the same speed). Similar results were recorded by Alton et al., 1998; Murray et al., 1985; Stolz et al., 1997; who discovered a decrease of some indicators of treadmill walking (time, frequency) in comparison with overground walking.

Kinetic researches of VGR, comparing treadmill and overground walking, are not very frequently published. Riley (2007) ascertained the course of forces during a stance were very similar; however, the magnitude of value peaks was significantly smaller at walking on a treadmill. Similarly, Parvataneni et al. (2009) showed the second peak during a stance is 5.5% lower in average on a treadmill than at overground walking.

The aim of the pilot experiment with a smaller number of subjects was to examine if it is possible to find differences between treadmill and overground walking in various inclinations and at various walking speed. We have not found the solution of the problem in accessible literature and our pilot experiment should suggest the extent of accordance or difference in various conditions on treadmill and at overground walking.

Methods

A comparison study has been done comparing field and laboratory testing of vertical ground reaction of walk (VGR) on a treadmill and at overground walking. Three subjects

(small sample size), classified as case studies, participated in the study. Male 56 years, 173 cm, 72 kg; male 20 years, 180 cm, 67 kg; female 19 years, 171 cm, 67 kg. Pedar mobile system (companies Novel, GER) has been used to get kinetic (VGR) and time parameters. Data were monitored using two pressure insoles placed in shoes of the subjects. Subjects absolved overground (0%) and uphill walking (9%) at respective velocities: 3, 4 and 5 km/h. Treadmill Lode Katana Sport 30 (Groningen, the Netherlands) was used for the laboratory examination. For the field research we used both a stretch of flat surface and a stretch of pavement ascent at the faculty. Speed regulation of subjects was done by using a cycle computer (Sigma) which had been checked for accuracy by means of photocells on 10 meters long stretch (error max. 10%).

The observed kinetic parameters: the peak value during the absorption phase (Loading Response, MidStance) marked as F_1 , the lowest value of the force during in decrease between both peaks (F_2), the second peak value during the propulsive phase (F_3 , Terminal Stance, PreSwing). Further we observed the average plantar force during the whole stance period (F_m).

For time parameters, we measured the whole duration of the stance (t), the duration of the first part of stance – absorption phase – t_1 (LR, MSt), the duration of the second part of stance – propulsive phase – t_2 (TSt, PSw). The subjects undertook natural walking for 15 seconds. The last 10 seconds were recorded and 3 successive stances of the right and left leg were analyzed. Each subject always performed 3 trials at the set velocity with set gradient of the pad.

Percentage differences between separate averages of flat surface trials and trials with increasing inclinations at corresponding velocities were calculated and they were compared using Effect of Size (Cohen d coefficient).

The Results and Discussion

All three subjects performed standard stance with two peaks and one decrease between them. The subject A performed less usual VGR stance progression with higher F_1 than F_3 , which is possible to observe at a minor part of population (Korvas 2013). The subject B performed typical plantar loading with lower values of F_1 than in the propulsive phase at F_3 . At the subject C, imbalanced results of VGR were recorded. In six trials a higher value of F_1 was recorded and in the next six trials it was F_3 which was higher, whereas the higher values of F_3 were reached by the subject during uphill walking.

The values of F_1 and F_3 were increasing at all subjects with rising speed both on flat surface and at uphill walking. On the contrary, the value of F_2 was decreasing with increasing speed. F_m values at all subjects were slightly higher during upward walking.

Nevertheless, statically significant differences were not found. Similarly, no significant differences for F_m between various speed walking in the same environment were recorded. It may indicate that the performance produced during the whole stance is similar in both observed environments, which is not, at the same speed and different conditions, quite logical.

Subject A

Tab. 1 The results of proband A

	BR1	BR2	BR3	B9 1	B9 2	B9 3	TR1	TR2	TR3	TK1	TK2	TK3
$F_m(N)$	526	530	546	506	523	538	546	553	558	537	539	560
sd	189	188	192	186	179	181	188	195	212	179	186	209
$F_1(N)$	688	699	749	616	652	721	680	740	805	640	669	802
SD	6	11	17	9	4	22	16	25	16	16	9	19
$F_2(N)$	609	592	546	585	578	508	594	566	537	592	561	539
SD	11	11	42	8	13	15	10	20	6	11	11	8
$F_3(N)$	654	655	696	661	667	699	708	678	732	687	713	723
SD	9	7	14	7	9	11	3	4	13	8	7	18
T (s)	0.83	0.79	0.64	0.88	0.74	0.68	0.80	0.75	0.72	0.88	0.78	0.73
SD	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.03	0.02	0.02	0.07	0.01
t_1 (s)	0.37	0.36	0.30	0.38	0.41	0.31	0.32	0.31	0.31	0.36	0.30	0.32
SD	0.14	0.09	0.02	0.06	0.15	0.01	0.02	0.01	0.03	0.08	0.01	0.01
t_2 (s)	0.46	0.42	0.35	0.50	0.44	0.37	0.48	0.45	0.39	0.52	0.46	0.40
SD	0.02	0.02	0.02	0.06	0.04	0.01	0.02	0.03	0.04	0.08	0.08	0.02

Legend: BR1 walk on flat, treadmill 3 km/h, BR2 walk on flat, treadmill 4 km/h, BR3 walk on flat, treadmill 5 km/h, B9 1 walk in uphill, treadmill 3 km/h, B9 2 walk in uphill, treadmill 4 km/h, B9 3 walk in uphill, treadmill 5 km/h, TR1 walk on flat, overground 3 km/h, TR2 walk on flat, overground 4 km/h, TR3 walk on flat, overground 5 km/h, TK1 walk in uphill, overground 3 km/h, TK2 walk in uphill, overground 4 km/h, TK3 walk in uphill, overground 5 km/h

The values of force indicators F_1 and F_3 which are significant for assessment of dynamic characteristics of one's walk were gradually increasing with rising velocity both on the treadmill and overground. Significant differences were recorded for almost all results between both fields at the same velocity ($d > 0.8$). Values of F_2 were with rising velocity gradually decreasing and they were usually considerably different between both fields at the same velocity. Relative values of F_m were quite low and they were in the range 74.5-79.4% of body weight (BW). Absolute values on the treadmill

were recorded in diverse range for particular value peaks, for F_1 87.2-102.1% BW, for F_3 92,6-99,0 % BW. Overground values were in ranges for F_1 90.7-114.4 % BW and for F_3 96.1-103.7 % BW at all velocities. These values are in average lower than it was recorded by other authors in ordinary population, especially on the treadmill. For example, according to Perry (2010) the ordinary population reaches both value peaks of planar forces the level of 110% BW, Kirtley (2004) recorded 117 % BW for F_1 and 107 % BW for F_3 . These results are comparable especially at higher velocities (4 and 5 km/h). In our previous research, it was found in female population the values for F_1 were in range 99-112 % BW, for F_3 107-121 % BW.

At time characteristics of a stance the longest contact time was recorded for velocity 3 km/h, at higher velocities the time was significantly shorter ($d > 0.8$). The stance period (t) was longer in inclination part of track, on the plain field no results were unequivocal. Total stance period was significantly changing at all velocities except uphill walking at 3 km/h, which is logical because there is usually higher frequency of strides and also other time parameters of motion cycle during walk are shorter. The stance period of our subject shortened in range depending on terrain between walking velocities 3 and 5 km/h in range 9.0-22.9 %. During the analyses of individual stance phases it was realized that the propulsive phase took always more time than the absorption phase. Significant differences in duration time of absorption phase were discovered only at uphill walking at 4 and 5 km/h. At the propulsive phase significant differences have been realized at all walking velocities during overground walking and uphill walking at 5 km/h. Propulsive phase shortened during walking at all types of measuring between 3 and 5 km/h in the range 18.7 %-23.9 %. Differences in absorption phase were significantly smaller, in the range 3.1-18.6%. The absorption phase was longer on the treadmill than overground and the propulsive period was shorter on the treadmill than at overground walking.

Subject B

Tab. 2 The results of proband B

	BR1	BR2	BR3	B9 1	B9 2	B9 3	TR1	TR2	TR3	TK1	TK2	TK3
F _m (N)	521	521	534	495	510	513	489	532	536	524	539	550
sd	190	192	187	183	182	197	201	191	197	197	193	199
F ₁ (N)	621	653	734	583	604	614	628	678	705	598	656	675
SD	12	16	29	13	38	11	15	17	11	16	13	14
F ₂ (N)	552	521	445	516	446	442	543	529	470	566	528	471
SD	10	11	25	23	19	6	15	11	16	12	23	11
F ₃ (N)	724	730	744	695	755	814	648	744	786	752	777	791
SD	6	8	29	12	13	5	47	18	8	17	14	10
T (s)	0.84	0.79	0.63	0.90	0.71	0.65	0.89	0.74	0.65	0.89	0.75	0.67
SD	0.01	0.01	0.01	0.01	0.01	0.01	0.05	0.01	0.01	0.04	0.02	0.01
t ₁ (s)	0.30	0.29	0.27	0.35	0.29	0.30	0.32	0.28	0.27	0.31	0.30	0.26
SD	0.02	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.02	0.01	0.01
t ₂ (s)	0.54	0.49	0.36	0.56	0.40	0.35	0.57	0.45	0.38	0.58	0.45	0.40
SD	0.03	0.02	0.01	0.13	0.03	0.01	0.04	0.00	0.01	0.02	0.02	0.02

At the second participant significant differences of VGR between treadmill and overground were recorded for F₁ with velocities of 4 and 5 km/h on the plain field with all velocities in gradient (d>0.8). For F₃ differences were recorded between both terrains with all velocities. At lowering values between both peaks (F₂) the majority of differences was significant except walking on flat surface at 3 and 4 km/h. Also here the differences are showing possibilities of differences in kinetic indicators when measuring in field and in a laboratory. The size of F_m reached higher relative values than in subject A, they were recorded in range 75.3-81.3 % BW on the treadmill and 74.4-83.7 % BW in field trials. Differences reached for F₁ the range 5.2-18.3 %, for F₂ 13.5-19.5 % and for F₃ 2.8-21.4 %.

At time parameters the differences were generally significant and for the total stance period were in the range 24.5-27.9 %. At the total stance period (t) the contact was found longer at overground walking during both the flat surface and uphill walking. A difference during the absorption phase was recorded for velocities of 3 and 4 km/h on the flat surface and 3 and 5 km/h at uphill walking. During the propulsive phase the majority of differences was significant and a shorter period of the phase was realized on the treadmill. Differences between the slowest and the fastest walk were in the absorption phase 8.2-16.0 %, in the propulsive phase 34.0-36.7 %.

At the second participant significant differences of VGR between treadmill and overground were recorded for F_1 with velocities of 4 and 5 km/h on the plain field with all velocities in gradient ($d>0.8$). For F_3 differences were recorded between both terrains with all velocities. At lowering values between both peaks (F_2) the majority of differences was significant except walking on flat surface at 3 and 4 km/h. Also here the differences are showing possibilities of differences in kinetic indicators when measuring in field and in a laboratory. The size of F_m reached higher relative values than in subject A, they were recorded in range 75.3-81.3 % BW on the treadmill and 74.4-83.7 % BW in field trials. Differences reached for F_1 the range 5.2-18.3 %, for F_2 13.5-19.5 % and for F_3 2.8-21.4 %.

At time parameters the differences were generally significant and for the total stance period were in the range 24.5-27.9 %. At the total stance period (t) the contact was found longer at overground walking during both the flat surface and uphill walking. A difference during the absorption phase was recorded for velocities of 3 and 4 km/h on the flat surface and 3 and 5 km/h at uphill walking. During the propulsive phase the majority of differences was significant and a shorter period of the phase was realized on the treadmill. Differences between the slowest and the fastest walk were in the absorption phase 8.2-16.0 %, in the propulsive phase 34.0-36.7 %.

Subject C

Tab. 3 The results of proband C

	BR1	BR2	BR3	B9 1	B9 2	B9 3	TR1	TR2	TR3	TK1	TK2	TK3
F_m (N)	514	518	534	497	501	526	526	539	561	534	529	559
sd	191	190	194	179	189	197	202	199	211	206	215	209
F_1 (N)	682	698	768	643	643	686	711	751	832	663	651	722
SD	6	9	7	11	11	15	18	22	10	16	18	24
F_2 (N)	587	565	437	495	495	459	618	550	487	614	595	505
SD	12	10	13	11	11	11	14	23	11	10	7	20
F_3 (N)	673	683	748	711	711	751	676	735	788	774	818	877
SD	13	10	12	21	21	4	10	12	11	11	17	25
T (s)	0.80	0.77	0.65	0.79	0.79	0.69	0.89	0.76	0.68	0.91	0.84	0.72
SD	0.01	0.01	0.01	0.05	0.05	0.02	0.04	0.03	0.00	0.04	0.03	0.02
t_1 (s)	0.37	0.37	0.32	0.35	0.35	0.34	0.41	0.39	0.34	0.42	0.43	0.33
SD	0.06	0.04	0.01	0.03	0.03	0.03	0.03	0.01	0.02	0.03	0.02	0.02
t_2 (s)	0.43	0.40	0.34	0.44	0.44	0.36	0.48	0.36	0.35	0.48	0.42	0.38
SD	0.07	0.05	0.01	0.05	0.05	0.02	0.03	0.03	0.01	0.04	0.02	0.01

At the last subject the majority of recorded differences was significant, however, the values were unlevelled and VGR was six times higher for the first peak and six times for the second one, whereas on the flat surface all the values recorded were higher for F_1 and at uphill walking all values were higher for F_3 . Value differences between the treadmill and field trials were generally higher and the degree of VGR was gradually lowering with increasing velocity. Subject C reached the highest relative values of plantar force in observed stance peaks at all three subjects. Simultaneously, their highest range was recorded. For F_1 on the treadmill, it was in the range 98.8-1.17 % BW, for F_2 67.0-89.9 % BW, for F_3 102-114.0 % BW and in the field for F_1 99.0-127.0 % BW, for F_2 74.0-94.0 % BW, for F_3 103.0-134.0 % BW. These values are at the velocity of 5 km/h both on the treadmill and at overground walking higher than presented by Perry (2010) and Kirtley (2004). Differences between walking 3 and 5 km/h reached for F_1 6.8-17.6 %, for F_2 7.3-25.5 % and for F_3 5.6-16.5 %. F_m values for the treadmill were recorded in the range 76.0-81.0 % and in terrain 80.0-85.5 %. Relative values of force parameters were the highest from observed subjects and they are higher than reported by Kirtley (2004), Perry (2010), Korvas (2012).

The total stance period (t) was again shortening with increasing velocity and also it was much longer in the field. The stance period shortened at the highest speed in the range 12.7-23.2 % in both measuring conditions. The absorption phase was generally longer in the field and we have realized generally significant differences between the treadmill and overground walking ($d > 0.8$). During the propulsive phase the period was shortening with increasing velocity and these differences were significant ($d > 0.8$). Differences between the treadmill and overground walking were very diverse, however, despite of the significance of differences, it is not possible to reasonably neither interpret nor characterize them. Shortening of contact period during the absorption phase was recorded in the range 2.9-21.1 % and for the propulsive phase it was 18.4-27.2 %.

We have found out that the changes in three observed VGR peaks are usually significantly different between treadmill walking and walking in natural environment with two different inclinations and three velocities which are common both in ordinary population and at trials. It might mean that walking on the treadmill is not completely identical from the point of view of dynamic characteristics of VGR and it is advisable to examine the differences in a larger subject sample of the ordinary population. Furthermore, it is advisable to research these changes from the point of view of other characteristics (EMG, physiology, kinematics) to provide a complex view. Differences may result even from uniquely set velocity and reliability at measuring on the treadmill. In field trials, despite of effort to reach reliable results, the results can be influenced by possible variation in walk velocity. Other possibilities of the research are in its focus on examining differences and changes of plantar pressures and forces at various velocities and gradients with more subjects because previous studies did not test walkers at different velocities and gradients, which is something we concern about the most.

Conclusion

We discovered certain differences indicating possibilities of different VGR quantity on the treadmill and in field in the research of walk. Therefore it will be useful to perform larger research with more subjects.

References

- F. Alton, L. Baldey, S. Caplan, M. C. Morrissey, (1998) A kinematic comparison of overground and treadmill walking. *Clinical Biomechanics*; 13: 434-440.
- Belli, A., Bui, P., Berger, A. & et al. (2001) A treadmill ergometer for threedimensional ground reaction forces measurement during walking. *J. Biomech*; 34, 1: 105-12.
- Dierick, F., Penta, M., Renaut, D., & et al. (2004) A force measuring treadmill in clinical gait analysis. *Gait Posture*; 20, 3: 299-303.
- Elliott, B. C. & Blanksby, B. A. (1976) A cinematographic analysis of overground and treadmill running by males and females. *Med. Sci. Sports*; 8: 84-77.
- Frishberg, B.A. (1983) An analysis of overground and treadmill sprinting. *Med. Sci. Sports Exer*; 15: 478-85.
- Kobylarz, R. (1990) Overground versus treadmill running. *Sport. Health*; 8: 33-4.
- Korvas, P., Musil, R., Došla, J., Kolářová, K., Pavlík, J., & Šenkýř, J. (2013) The study of vertical ground reaction during walk of Czech women. *Journal of Human Sport and Exercise*, Faculty of Education. Univ. of Alicante; 8, 2, p. 54-60.
- Korvas, P., Musil, R., Došla, J., Cacek, J. (2012) Cross-sectional comparison of selected gait characteristics of woman of different age. In *Proceedings: EMED Scientific Meeting 2012*. Denmark, Aalborg; 1.-4. 8. 2012.
- Lafortune, M. A., Hennig, E. M., & Milani, T. (1994) Comparison of treadmill and overground running. *Eighth Biennial Conference, Canadian Society for Biomechanics*; 90-91.
- Murray, M. P., Spurr, G. B., Sepic, S. B., Gardner, G. M. & Mollinger, L. A. (1985) Treadmill versus floor walking: kinematics, electromyogram, and heart rate. *J. Appl. Physiol.* 59, 87-91.
- Nelson, R. C., Dillman, C. J., Lagasse, P. & Bickett, P. (1972) Biomechanics of overground versus treadmill running. *Med. Sci. Sports*; 4: 233-40.

- Nigg, B. M., De Boer, R., & Fisher, V. (1995) A kinematic comparison of overground and treadmill running. *Med. Sci. Sports Exerc*; 27: 98-105.
- Nelson, R. C., Dillman, C. J., Lagasse, P., & et al. (1972) Biomechanics of overground versus treadmill running. *Med Sci Sports*; 4, 4: 233-40.
- Parvataneni, K., Ploeg, L., Olney, S. J., & Brouwer, B. (2009) Kinematic, kinetic and metabolic parameters of treadmill versus overground walking in healthy older adults. *Clinical Biomechanics*; 24, 95-100.
- Riley, P. O., Paolini, G., Della Croce, U., Paylo, K. W., & Kerrigan, D. C. (2007) A kinematic and kinetic comparison of overground and treadmill walking in healthy subjects *Gait & Posture*; 26, 17-24.
- Stolz, H., Kutzt-Buschbeck, J. P., Mondwurf, C., Boczek-Funcke, A., Johnk, K., Deuschl, G. & Illert, M. (1997). Gait analysis during treadmill and overground locomotion in children and adults. *EEG Clin. Neurophysiol*; 105, 490-497.
- Strathy, G. M., Chao, E. Y. & Laughman, R. K. (1983) Changes in knee flexion associated with treadmill ambulation. *J. Biomech*; 16: 517-22.
- Van Ingen Schenau G. J. (1980) Some fundamental aspects of the biomechanics of overground versus treadmill locomotion. *Med. Sci. Sports Exerc*; 12, 4, 257-61.
- Wass, E., Taylor, N. F., & Matsas, A. (2005) Familiarisation to treadmill walking in unimpaired older people. *Gait Posture*; 21(1): 72-9.
- White, S. C., Yack, H. J., Tucker, C. A. & Lin, H. (1998) Comparison of vertical ground reaction forces during overground and treadmill walking. *Med. Sci. Sport. Exerc*; 30, 1537-1542.

Evaluation and Development of Coordination Abilities by Children with Mental Disability

Gabriela Kavalířová, Věra Knappová

Faculty of Education, University of West Bohemia, Plzeň, Czech Republic

Abstract

Presented study is focused on evaluation of the level and development of coordination abilities by children with mental disability. The Movement Assessment Battery for Children 2 (MABC-2) for diagnostics of developmental coordination disorder that evaluates and describes imperfections of motor performance was used to examine them. On the basis of the entrance examination we determined and implemented movement intervention focused on areas, in which we found out lower level of abilities and skills. The examined individuals were all boys and girls with middle mental disability that attend the Special Elementary School in Pilsen. Their age range was quite huge from 5 to 18 years. But their mental age was determined by psychologist from 4 to 6 years. We focused on the assessment of tasks from MABC-2 for 3-6 years old children with evaluation for the intact population in age 5.0-5.9 years – this is the level meeting the mental age of probands. They performed eight different tasks from three areas – manual dexterity, ball skills, static and dynamic balance. According to the table of results we determined the strong difficulties during the movement by 61 % of pupils. By 11% of children we determined increased risk of movement difficulties. Twenty eight percent of pupils were without movement problems. The most marked problems were noticed in the tests that required longer concentration, as for example posting coins. Then we see the static balance as the next problematic area. Some pupils were not able to perform the task at all or they finished it in the first two seconds. During testing we found differences among children. It was apparent that older children were in some motor skills more mature and their mental age was from this tested point of view higher, than it was set by the psychological examination. We suggest that the area of motor testing of mental age could be enriched with this methodology and that the test is easily usable for the most of professionals working with individuals with special needs.

Keywords: *Mental disability, children, motorics, movement coordination.*

Introduction

In presented paper we focus on the problem of level of coordination by children with mental disability. It is obvious that coordination by these individuals is worsened,

which has impact on the quality of their life. It is demonstrated by e.g. inappropriate timing of movement, disrupted time-space sequence of movement and so on. The strong difficulties are noticed when performing sport and movement activities. Children perform the exercises in inaccurate way. We notice the worsened balance, slight tremble and other imperfections by them.

According to Doty, McEven, Parker & Laskin (1999), the quality of coordination of the movement significantly influences the everyday life of a man and creates preconditions for effective acquiring motor skills. However children with mental disability are not able to perform the most of the motor skills on the same level as their intact same-age peers.

Among the fundamental motor skills belong stability, locomotor movements (walking, running, hopping, jumping and galloping) and manipulation with objects (throwing, catching and kicking) (Doty, McEven, Parker & Laskin, 1999; Gallahue, 1996). For individuals with specific needs is generally the most important merit in development of fundamental motor skills, especially functional skills, which are necessary for performing movements required in common life.

Disrupted coordination can cause difficulties e.g. when tying the laces up, buttoning and undoing the buttons, holding knife and fork, balancing, in space orientation, worsened movement rhythmicity connected with fundamental locomotion and so on. It is further projected in the area of social integration. Imperfections in movement coordination by children with specific needs strongly project to quality of their life and negatively influence besides other things their psyche and group position.

Our work is focused on evaluation of the level of fundamental motor skills and fine motor skills by this specific group of children and mainly on the work with them. On the basis of published knowledge about the appropriate movement interventions for development of movement coordination by intact children we decided to apply chosen specific movement exercises by targeted group of children with specific needs. We find as the appropriate exercises for example exercises from rhythmic gymnastics (music-movement education, manipulation with apparatuses, balance preparation and so on), psychomotorics and like that.

Methods

The study was conducted with compliance with Code of Ethics at University of West Bohemia.

The Movement Assessment Battery for Children 2 (MABC-2) for diagnostics of developmental coordination disorder that evaluates and describes imperfections of motor performance was used to examine children with mental disability. The standardized

tools are used, e.g. coins, pegs, small beanbag, pads, balance beam and so on. This test battery is time-consuming as well as material demanding. Execution of the test by intact population lasts 30 minutes (Johnson, 2006).

MABC (the first version of MABC-2) was validated for use in the childhood population with mental retardation in many countries around the world – USA, Norway, Sweden, China and others. In the Czech environment it was first used in a study (Kathleen & Válková, 2007) for preschoolers with mental retardation and developmental delay.

The entrance testing took place at Special Elementary School in Pilsen at the beginning of this year. Currently we are trying to improve and develop the level of coordination abilities of tested children by means of targeted movement activities. Children exercise two times a week for 40-60 minutes. The content of the exercises is formed from rhythmic gymnastics – locomotor movements with music, simple dances, manipulation with apparatuses (ball, hoop, scarf and so on) and balance exercises. We also use means of psychomotorics and drumming on gymnastic balls. After finishing the intervention program we want to verify the improvement of children by the exit testing.

MABC-2 contains eight tasks in each from three age ranges: 3-6, 7-10 and 11-16 years. Tasks are divided to following three areas: manual dexterity, ball skills, static and dynamic balance. The examined individuals were boys and girls in age 5-18 years that attend the special school. We worked with eighteen pupils with middle mental disability. Their mean mental age was determined by psychologist from 4 to 6 years. Testing includes various tasks according to the calendar age. In this paper we focus on the assessment of tasks for 3-6 years old children with evaluation for the intact population in age 5.0-5.9 years – this is the level meeting the mental age of probands.

The age category of 3-6 years contains these eight tasks:

- Posting coins
- Threading beads
- Bicycle trail I
- Catching bean bag
- Throwing bean bag onto mat
- One leg balance
- Walking heels raised
- Jumping in squares

Qualitative performances are elaborated for each task separately. If a pupil is in some exercise markedly worse, qualitative performances can serve us as a guideline for determining causes (Johnson, 2006). We find the results according to the tables, which are created in dependence to the age of pupils. We transfer this entry to standard score (SS). Some tasks are necessary to perform with both limbs. In such case we make the average value from the SS results.

According to the results the pupils are divided into the following performance groups (see table 1):

Tab. 1 The total score (Engel-Yeger, B. & Rosenblum, S. & Josman, N., 2010)

Child score	Total score	Percentile	Test result
Red zone	56 and less	to 5 P	movement difficulties
Amber zone	57 to 67	5 to 15 P	risk of movement difficulties
Green zone	over 67	over 15 P	without movement difficulties

Standard scores are gained separately from three groups of tasks (manual dexterity, ball skills, static and dynamic balance). Standard scores are in close connection to standard deviations (see Fig. 1). If two standard deviations are determined by the pupil or he/she is under the average value, it is necessary to approach to this pupil individually, to pay attention to and help him/her more in this area. Pupils with one standard deviation belong to the risk group.

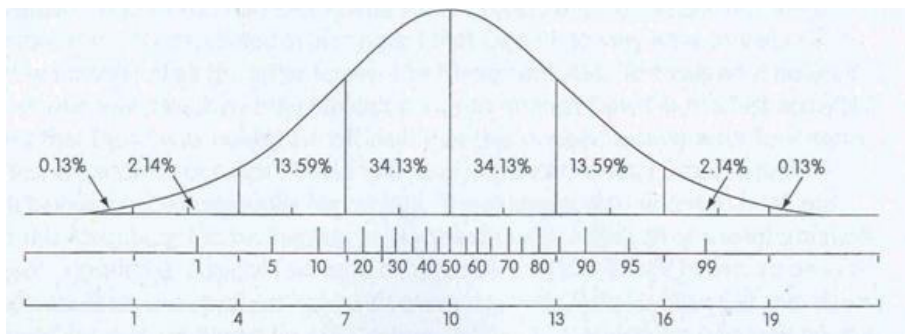


Fig. 1 The standard deviation and standard score in the test MABC-2 (Engel-Yeger, B. & Rosenblum, S. & Josman, N., 2010)

The upper curve of the graph shows the percentage of occurrences, the middle one shows the percentage range and the low line demonstrates the standard score in the test MABC-2.

During the applied movement intervention we focused on movements which pupils have the biggest troubles with: keeping the balance, space orientation and rhythmic exercises.

Within the first lessons we used the help of teachers, who understand children and better communicate our demands to them. In following lessons we were able to communicate with pupils by ourselves.

When practicing motor skills we simultaneously paid attention to the individually optimal body posture and health and functional benefit of the exercise.

Results

Already during the entrance testing we noticed the motor difference by pupils with specific needs, primarily in areas of balance and kinesthetic-orientation. So in the movement intervention we focused on development of abilities from the mentioned areas.

In the tables 2 and 3 we can see the data from all tasks together. Numbers of particular tasks are transferred to SS and add up, possibly divided, if it was performed with both upper limbs. Afterwards the numbers were transferred to percentiles and ranked to the performance tables.

Tab. 2 The total score of the tested probands

Child score	Number of probands (%)	Test result
Red zone	11 (61%)	movement difficulties
Amber zone	2 (11%)	risk of movement difficulties
Green zone	5 (28%)	without movement difficulties

Tab. 3 The more detailed results of the testing

TEST	Average value from all probands (standard score)	Minimum/maximum (standard score)
Posting coins	3.33	1 / 9.5
Threading beads	9.22	1 / 17
Bicycle trail I	4.33	1 / 12
Catching bean bag	9.33	5 / 17
Throwing bean bag onto the mat	10.03	1 / 19
One leg balance	5.91	3 / 14
Walking heels raised	3	1 / 12
Jumping in squares	4.75	1 / 12

$ss.max = 94.125$ $ss.min = 14$ $Pmax = 91$ $Pmin = 0.1$

After the first testing, according to the table of results, 61% of pupils belong to the red zone, which determines the strong difficulties during the movement. 11% of children belong to the amber zone with increased risk of movement difficulties. 28% of pupils are without movement problems, so belong to the green zone.

The most marked problems were noticed in the tests that required longer concentration, as for example posting coins. It was also complicated by the fact children

did not know the movement task. Then we see the static balance as the next problematic area. Some pupils were not able to perform the task at all or they finished it in the first two seconds.

The area of manual dexterity was the least enjoyable for pupils, because of its lengthiness as well as limited ability of children to keep attention on one task. We had to convince children many times to keep the given number of trials and not to leave before the end. In spite of that many pupils rejected the second repetition of the tested task.

Discussion

The test battery MABC-2 is primarily set for intact children, but with small adjustments can determine the level of movement coordination also by individuals with specific needs.

During testing we found differences among children. It was obvious that older children were in some motor skills more mature and their mental age was from this tested point of view higher than it was set by the psychological examination. We suggest that the area of motor testing of mental age could be enriched with this methodology and that the test is easily usable for the most of professionals working with individuals with special needs.

The test is according to the authors appropriate for doctors, therapists, pedagogues, nurses and special workers. It does not demand the special training. Self-study is sufficient for understanding and using the test MABC-2. On the basis of the qualitative and quantitative examination can be found out the motor difference of children. Afterwards we are able to determine diagnosis or to give them certain recommendations.

Conclusions

The aim of this work was to find out the level of coordination abilities of children with mental disability.

We found differences in coordination, primarily in balance and orientation abilities by them. Difficulties can be found in manual dexterity, mainly when performing new activities. Children have also problems with locomotion, which was adjusted in some way. We suggest that these disorders will be manifested during common outdoor movements, primarily in unknown environment. Children can make an injury or they can slip or fall in more difficult conditions. All these observed differences have also the impact on static and dynamic part of the movement apparatus. We meet the wrong body posture by these children with specific needs more than it is in the intact children population.

From the reason that children in most cases did not gain the optimal score in coordination tests (Movement Assessment Battery for Children 2) but also from the preventive and intervention reason considering the appearance of the wrong body posture we recommend to incorporate the regular movement intervention of psychomotor and compensation character to general lessons of physical education.

References

- Doty, A. & McEven, I. & Parker, D. & Laskin, J. (1999). Effects of testing context on ball skill performance in 5-year-old children with and without developmental delay. *Physical Therapy*. vol. 79, p. 818-826.
- Eichstaedt, C. & Lavay, B., W. (1992). *Physical activity for individuals with mental retardation: Infancy through adulthood*. Champaign, IL: Human Kinetics.
- Engel-Yeger, B. & Rosenblum, S. & Josman, N. (2010). *Movement Assessment Battery for children (M-ABC)*.
- Gallahue, D. L. (1996). *Development physical education for today's children*. Dubuque, IA: Brown & Benchmark.
- Kathleen, F. & Válková, H. (2007). Motor skill development in preschool children with mental and developmental disorders – the difference after a one year comprehensive education program. *Acta Univ. Palacki. Olomouc*. vol. 37, no. 4, p. 91-98.

Differences in the activation of selected muscles throughout a curve with the use of internal stabilizer in handicapped skiing group LW2

Petra Matošková, Vladimír Süß, Bronislav Kračmar

Faculty of Physical Education and Sport, Charles University in Prague, Czech Republic

Abstract

Alpine disciplines of handicapped skiers do not only belong among competitive disciplines at the Paralympic Games, but also create certain form of leisure time physical activities of handicapped population. Whether skiing is an appropriate physical activity for individuals after unilateral above-knee amputation is often discussed, because of the high load placed on the healthy leg. The aim of this research was to compare the activity of selected muscles throughout curves using an internal stabilizer for skiers LW2 groups, i.e. skiers with unilateral above-knee amputation. The research consisted of a comparison of two case studies and an analysis of specific physical activities – skiing with unilateral above-knee amputation. It is a description based on surface electromyography and kinematic video analysis of the curves.

The sample included two skiers (one male and one female) aged 22-30 years. The results show variability throughout the curves on the inner and outer edge of the ski for both interindividual and intraindividual comparison of the presented types of curves.

Keywords: *handicapped people, skiing, surface electromyography.*

The project was supported by Czech Republic's Ministry of Education, Youth and Physical Education MSM 0021620864 and program PRVOUK no. 38.

Introduction

Alpine Skiing of handicapped skiers was for the first time introduced to the Paralympic Winter Games in 1976 in Örnsköldsvik, Sweden and included slalom and giant slalom. Currently athletes compete in all four alpine disciplines. However, skiing is one of many physical leisure activities for the majority of physically disabled people. It brings them intense personal experience, feeling of speed, they can execute almost the same activity as healthy skiers. It is often debated, whether skiing is suitable for people, who went through a unilateral above-knee amputation due to significant overexertion of healthy legs, because skiers do not use a prosthesis only on one ski; they use two stabilizers. Matošková and Süß (2002, 2003) examined a specific issue of motivation in disabled skiers and their research showed that an important motivating factor is the fact that they

feel like healthy individuals going in similar speed and feelings from slides. Moreover, another factor is overcoming the handicap and group inclusion. A three-point support system is first being used in beginners. That is later, however, a limiting factor related to the range of motion. Therefore, more advanced skiers, who have already developed a better sense of slides and sufficient balance, use only an internal stabilizer, that is in contact with snow throughout the curve.

Curve on the inner edge of a ski with the use of inner stabilizer

A skier starts a slight curve by advancing his inner arm with the internal stabilizer forward simultaneously with a slight knee bend in the sagittal plane of the standing leg and a moderate knee tilt going towards the inside of the curve. Until the top of the curve there is no significant knee bend in the standing leg because of the reduced support of one stabilizer. Knee is on the other hand significantly pushed towards the inside of the curve because of more body weight that is placed on it and because it is not being supported by an external stabilizer. Skier's body tilts more in the frontal plane, while trunk bending forward is relatively insignificant. The inner arm and its shoulder in the frontal plane moves away from the body. Bigger knee bend of the standing leg starts from the top of the curve. The shoulder joint in the frontal plane moves the arm back to the body. The other arm with the external stabilizer is above the snow level and its position throughout the curve is very individual.

Curve on the outer edge of a ski with the use of inner stabilizer

Skier's movement throughout the curve is similar to the curve previously described – on the inner edge of the ski. The only difference is that the trunk is being bent more until the top of the curve compared to the curve on the inner edge.

When describing changes in skier's posture we used quantitative data obtained from 3D kinematic analysis in each experiment of monitored participants (not in absolute values of the angle but by following the trend – change in the size of the angle throughout the curve). In order to describe the curve, we used previously defined critical points occurring throughout the skiing motion of individuals with unilateral above-knee amputation (Matoskova, Zahálka and Süß, 2003) clarified later (Matošková, 2005). There are four critical points throughout the curve.

Critical point I. It is the moment of transition, when a skier tilts towards the next curve. It occurs, when the trajectory of a head intersects the trajectory of the tip of the shoe, illustrated in the plane of „xz“.

Critical point II. The vertical level of hips is being lowered down at the beginning of the curve. This critical point is the moment with a significant increase of vertical speed associated with skier's hips .

Critical point III – top of the curve. This is a critical point defined by the slope of skier's body within the frontal plane. It can be characterized by the distance of two projections – head and toes of skier's shoes – within the plane of „xz“. The critical point is defined at the maximal distance of these two projections.

Critical point IV. This is a moment with a significant increase of vertical velocity in skier's hips – to increase the vertical hips' level.

The aim of this research was to compare the activity of selected muscles within the curves using an internal stabilizer in skiing handicapped group LW2, such as skiers with unilateral above-knee amputation.

Methods

The research was based on two case studies (descriptive analysis) of a specific activity – skiing of skiers with unilateral above-knee amputation. It was a sequential triangulation using quantitative-qualitative approach (Hendl, 1997). The study was primarily based on quantitative description of a skiing curve using 3D kinematic analysis and electromyography. Qualitative description following this stage arises from the principle of qualitative analysis of motor skills using critical points within the specific activity of skiers with unilateral above-knee amputation.

The group included two skiers – one man and one woman at the age of 22-30 years.

1. Kinematic analysis

We used a 3D kinematic analysis to define the critical points in curves. It was based on video analysis using software called TEMA Motion. Observed variables were defined for identification of critical points: toe, right hip, skier's head, right and left base of the stabilizer.

2. Electromyography records

Surface electromyography was used to describe muscle involvement. Selection of monitored muscles was limited by the number of channels in the EMG machine. The following muscles were selected: m. adductor longus, m. tensor facie latae, m. gluteus medius, m. gastrocnemius, m. peroneus longus; all muscles were measured on the unamputated left leg.

Electrodes were attached to the muscles according to Travell and Simons (1999). EMG records were synchronized with video recordings in order to determine muscles' electrical activity. Synchronized start of every unit of the analysis was set after we determined the comparative units (experiment) using the autocorrelation analysis (Konrad, 2009). The onset of the EMG recording was set based on the selection of the highest possible correlation between the results of the comparative unit and the selected unit of analysis. The sampling frequency was 200 Hz.

Results

First, we focused on monitoring changes in posture and their influence on skiers' use of support on a stabilizer throughout the curve. To determine the support we watched the progress of the vertical component of the inner and outer base of the stabilizer (Matoskova, 2006, The inner stabilizer is in contact with snow throughout the whole time of the course in both types of curves (on the inner and outer edge of the ski) except at the start of the curve. Contact time with snow is much shorter in case of the curve ridden on the outer edge of the ski compared to the curve ridden on the inner edge of the ski (about 20%). The outer arm with the external stabilizer is above snow and its position throughout the whole curve is very individual reaching height of 0.5 to 0.6 meters.

The next step of analysis of electromyographic recordings included the definition of the critical points using kinematic analysis. Critical points were set on the basis of research done by Matoskova (2005). We used standardized time data and results are summarized in Table 1.

Tab. 1 Percentage point of critical points throughout the curves

Critical point	I	II	III	IV
Inner edge of the ski	0	23%	53%	76%
Outer edge of the ski	0	10%	44%	84%

Discussion

Kinesiology comment on the function of monitored muscles

Based on the results of EMG activity in selected muscles it can be concluded that it is not a case of locomotor function of muscles but rather of postural arrangement, within which the posture is maintained in terms of gravity, centrifugal and centripetal forces and acceleration and deceleration. It corresponds with the results of comparison of walking and curves using a polyEMG method in downhill skiing (Sedliska, 2007). The second remark is the involvement of stabilizers throughout a curve driven on the inner edge of the ski of amputee skiers. Differences in postural maintenance on the inner edge of the foot are then even bigger, because in this case leg and stabilizer provides balance within the frontal plane, while postural maintenance on the outer edge is held only by the leg.

Musculus adductor longus (m.add.l.) in males reported significantly lower level of activation at the top of the curve on the outer edge compared to the curve on the inner edge. That happens because it is not working in a form of adductors as it is throughout the curve on the inner edge. Amputated limbs create a non-standard situation. Main-

taining bipedal posture is by handicapped people perceived as comfortable, if medians go through the soles. Once it starts getting near their outer edge, they feel postural discomfort. However, a one-legged skier does not have another option and the course of *m.add.l.* activation on the outer and inner edge is clearly confirmed in male version. Female version is similar, but not so obvious. Local maximum before the transitionally phase of the curve shows the place, where the muscle turns torso in the opposite direction of the tilt. *M.add.l.* in the curve on the outer edge does not work in greater knee flexion (when the knee is severely limited) than it does in the curve on the inner edge. Therefore, it can promote the onset of tumbling body to the opposite inclination more significantly in terms of posture.

Musculus tensor fasciae latae (*m.tens.fasc.lat.*) on the EMG curve reports a bigger area in both male and female version throughout the course on the inner edge (in unaffected population in normal mode) compared to the curve on the outer edge. *M.tens.fasc.lat.* throughout naturally performed curve on the inner edge of the outer ski keeps the trunk of the skier against the centripetal force throughout the whole curve. However, this function is missing in the opposite curve. In males there is confrontation of its activation in relation to *m.add.l.* – this muscle, as well as *m.tens.fasc.lat.*, is being contracted throughout the curve ridden on the inner edge of the top of the curve (the inclination of a skier towards the curve) and that ensures balance at the moment of skier's largest inclination within frontal plane.

Musculus gluteus medius (*m.glut.med.*) in male version of curves shows similarities in activation. That does not occur in female version of curves. Male downhill thus illustrates a higher degree of assimilation in postural position after amputation, when the *m.glut.med.* is being activated symmetrically on both sides. Female downhill does not show this type of assimilation. However, it shows a significant difference between activation on the inner and outer side of the ski. Male version of handicapped downhill skiing shows that in order to maintain stability via *m.glut.med.*, skiers go through curves on both sides almost like monoski, which is an optimal situation for skiers after unilateral amputation.

Musculus gastrocnemius (*m.gastr.*) shows similar dynamics on EMG recordings in curves on the outer edge in both males and females. Males' execution of the curves is compared to females' execution delayed. In addition, it has multiple local maximums corresponding more with the phase of transition between curves, which we consider to be the correct motor stereotype because the center of gravity during the phase of transition between curves should be located at the highest place. Male curves on the inside edge of skis show increase in activation of *m.gastr.* of approximately 85 % of monitored stepping cycle or more. It is a type of preparation for the rise of gravity center and its shift forward for the correct execution of movement on the outer edge of the ski throughout the curves implemented in bigger bend forward. As mentioned

in the description of *m.add.l.* activation, skiers that were amputated have no choice. It can be compared with similar research of healthy population and a moment of lifting own leg in order to make a step during walking and Nordic walking (Skopek, Kracmar, Spulak, 2012). Bending forward compensates for a smaller knee flexion in curves on the outer edge of the ski that is not possible in conditions of previously described postural discomfort occurring on the outer edge of own feet.

Musculus peroneus longus (*m.per.l.*) in female curves on the outer edge engages more in a form of contraction with functional antagonist *m.gastr* compared to male curves. That shows lower level of differentiation in muscle function. This generalization of muscle activation usually shows a lower degree of movement economy. In male curves on the outer edge we found a higher degree of reciprocity in relation to *m.gastr*. However, fundamental knowledge from observation of *m.per.l* work is the confirmation of *m.per.l.* function in postural placement of skiing curves. The results show higher amplitude of the EMG curve in both male and female version at the top of the skiing curves, which is the biggest tilt of the skier in frontal plane and thus associates with vectors of the largest forces affecting the leg of the skier in curves on the inner edge of the ski compared to curves on the outer edge of the ski. *M.per.l.* maintains the position of ski against resistant forces in curves on the inner edge of the ski as it puts the foot into eversion (pronation), while the outer edge maintains ski in a function of inversion (supination), which belongs to the functional antagonist in the frontal plane – *musculus tibialis anterior* – not monitored in the present study.

Conclusions

In three out of five monitored muscles – *m.add.l.*, *m.tens.fasc.lat.*, *m.gastr*: we found differences in the level of intensity in working muscles confirming „postural discomfort“ of postural maintenance of balance on the outer edge of bottom feet. Activation of *m.per.l.* objectifies its foot placement function in the sense of inversion – eversion. Its function of dorsal foot flexion is accompanied by eversion of foot functions. This feature keeps the foot on the inner edge. The outer edge of the foot (curve on the outer edge) requires involvement of *musculus tibialis anterior*, which was not observed, performing the inversion of the foot and keeping it on the outer edge. Relatively symmetric function in terms of laterality of performed work is required from the postural muscle *m.glut.med.*. That leads to improved performance of particular physical activity. While in muscles with the prevalence of phasic and locomotor activity – *m.gastr.*, *m.per.l.* – reciprocal mode of muscle activation is required as opposed to generalized contraction showing lower efficiency of incurred muscle work.

References

Hendl, J. Metodická triangulace v empirickém výzkumu. Česká kinantropologie, 1997, č. 1, s. 75-85.

Konrad, P. The ABC of EMG., 2009. uloženo na [www:http://reseau.risc.cnrs.fr/fichiers/apercu.php?numero=1](http://reseau.risc.cnrs.fr/fichiers/apercu.php?numero=1)

Matošková, P. Deskripce specifické lokomoce lyžařů s jednostrannou nadkolenní amputací. Disertační práce. Praha: UK FTVS, 2005.

Matošková, P., Süß, V. Co vede hendikepované lyžaře do hor. In Dobrý, L., Souček, O. (eds.) Pedagogická kinantropologie 2003: sborník sekce pedagogické kinantropologie České kinantropologické společnosti. Praha: Karolinum, 2003, s. 137-141.

Matošková, P., Süß, V. Proč lidé lyžují? In Hanzalíková, T., Šoltys, O., Víšek, J. (eds.) Sborník příspěvků ze studentské vědecké konference v Praze 26. a 27. 4. 2002. Praha: FSV, 2002, s. 251-258.

Matošková, P., Zahálka, F., Süß, V. Stanovení kritických míst v průběhu oblouku lyžaře s jednostrannou nadkolenní amputací. In Vindušková, J., Chrudimský, J. (eds.) Pohybové aktivity jako prostředek ovlivňování člověka: sborník příspěvků z vědecké konference sportovní sekce, Praha 20. 11. 2003. Praha UK FTVS, 2003, s. 341-343.

Sedliská, V. Analýza aktivity vybraných svalů dolních končetin při zatáčení na carvingových lyžích a porovnání s jejich aktivitou při volné bipedální chůzi. Diplomová práce. Praha: UK FTVS, 2007.

Škopek, M., Kračmar, B., Špulák, D. Monitoring of changes of the involvement by EMG in the areas of pelvic girdle, shoulder girdle, and back in the process of walking end Nordic walking. Journal of Outdoor Activities. 2012, vol. 6, no. 1, p. 6-19.

Travel, J. G., Simons, D. G. Myofascial Pain and Dysfunction: the triggerpoint manual. Vol. 1. Baltimore: Williams & Wilkins 1999.

Balance Abilities of Adult Population in Relation to Their Physical Activity

Tomáš Věspalec, Martin Zvonař, Josef Pavlík, Jindřich Pavlík

Faculty of Sports Studies, Masaryk University, Brno, Czech Republic

Abstract

The aim of our research was to find out if sufficient physical activity could be a positive factor that increases the level of coordination abilities of adult population. One of the fundamental – balance ties were selected out of the spectrum of coordination abilities. The study was to focused on adult population in the Czech Republic older than 30 years.

The research was split into two parts. First part, in which quantitative data about physical activity and mobility habits by means of questionnaire inquiring was collected; data from 1171 respondents (490 men, 681 women; av. age 47.6 years). The second part of the research was focused on balance abilities testing. Finally 163 participants took part in 3 motor tests (58 men, 107 women; av. age 44.3 years).

Measured and computed results indicate significant differences between respondents with sufficient and insufficient physical activity in majority of tests. Differences were found both within the male and female groups. The only test without significant difference was the static balance test with closed eyes measured in men's group.

Keywords: *balance abilities, static balance (SWAY), dynamic balance, physical activity.*

Introduction

Balance abilities play an important role in many areas of daily life, work and leisure activities. This is not just about the need to keep the body in a balanced position in a gravitational field. Equally important is the ability to maintain balance during locomotion, which is accompanied by an individual's first steps practically all his life.

Level of balance abilities are changing during life. After the progression and peak occurs in adults with increasing age the gradual involution changes related to aging of the organism, but also due to the negative impact of living and working environment, illness or accident.

Maintaining a sufficient degree of balance abilities is then an important factor affecting the quality of life of individuals as well as later in life. For the older age group, it is not only a priority their level skills to improve, but rather to maintain a given level or

minimize their loss. As mentioned, there are many factors which affect the ontogeny of balance abilities. However, is it possible to slow down, or in some way only partially reversed the involution? We think so.

Positive effects of specific intervention programs on balance ability were investigated and proven in many studies (from latest Machovec (2012), Kopřivová et al. (2007)). So we expect a similar positive effect, with significantly higher areal effect, even general physical activity. Intervention programs are usually limited by exposing to relatively narrow and often specific population group. In this work, we would like to demonstrate that a defined quantitatively measure physical activity (PA) has a positive effect on the level of balance ability with adult people.

In today's "hypokinetic" time we would like to contribute to the knowledge that, in addition to demonstrable health effects of physical inadequacy, is the range of its influence much wider. From the economic aspect with regard to the planned extension of working age, we must emphasize that for some particular manual professions is one of the predictors of successful performance the adequate level of motor skills.

Methods

Our research was conducted in 2009-2011 as part of the doctoral thesis of one of the authors and included the impact of a wider range of physical activities and lifestyle habits to a level of balance abilities.

Described research was divided into two parts. In the first part of the questionnaire we collected data of physical activity, demographic and somatic information and life habits of the adult population in the Czech Republic. Second part of the research was focused on motor testing and determines real level of coordination skills of the adult population. The results were statistically analyzed and compared with the results of the first part of the research.

Subjects and their selection

First part of the survey collected data on physical activity in the population older than 30 years in the Czech Republic and was attended by a total of 1,171 respondents, including 681 women and 490 men. Respondents were approached by students of Masaryk University Brno and University of West Bohemia in Pilsen. This choice was therefore made on the principle of availability. A detailed description of the interviewee's file is in Tab. 1. Instead of using average values and standard deviation of whole group we decided to divide tested population sample to age groups and describe each of them. That can give more illustrative description of particular age groups.

Tab. 1 Description of questionnaire respondents file

Age group		n	Mean values			
			age	BMI	height [cm]	weight [kg]
30 - 39	men	170	33.8	23.5	167.6	65.8
	women	80	33.2	25.7	178.7	82
	TOTAL	250	33.6	24.2	171.2	71
40 - 49	men	270	44.9	24	166.9	66.8
	women	203	45.8	26.8	179.9	87.1
	TOTAL	473	45.3	25.2	172.5	75.5
50 - 59	men	155	53.7	23.7	166.3	65.5
	women	129	54.1	26.7	179.2	85.7
	TOTAL	284	53.9	25.1	172.1	74.6
60 and more	men	86	65.2	24.3	166.4	67.3
	women	78	66.3	27.4	179.5	88.5
	TOTAL	164	65.7	25.8	172.7	77.5

Tab. 2 Description of group of participants in motor testing

Age group		n	Mean values			
			age	BMI	height [cm]	weight [kg]
30 - 39	men	36	32.6	23	167.7	64.5
	women	19	31.9	24.8	178.6	79.2
	TOTAL	55	32.4	23.6	171.5	69.6
40 - 49	men	38	45.5	24	167.4	67.3
	women	21	45.8	27.3	179.9	88.9
	TOTAL	59	45.6	25.2	171.8	75
50 - 59	men	27	53	24.9	165.1	67.8
	women	14	53.9	26.5	174.6	80.6
	TOTAL	41	53.3	25.4	168.3	72.2
60 and more	men	4	69.5	25.7	162.5	67.8
	women	4	63	29.1	172.8	87
	TOTAL	8	66.3	27.4	167.6	77.4

Second part of the research was to test motor skills. Attended by 163 people. The sample included 105 women and 58 men who took part in the survey. It was a sub-sample of respondents the survey. Selection of this group was carried out on a voluntary basis. More detailed description of the group is contained in Table 2.

Health section of the questionnaire from the first part of the survey was used as a limiting factor and those with serious health problems or those suffering from orthopedic complications weren't included in the second part of the research. Their performance in motor tests could be substantially affected by the health aspects.

Questionnaire

First part of the survey used the questionnaire that detects the amount of physical activity and health taken by Fiala (2002). This questionnaire has been used successfully at the Sport Faculty of Masaryk University in previous studies – Zvonař (2005), Šrámková (2012) and was also accompanied by questions ascertaining respondents' exercise habits and daily time spent in sitting position, in a standing position and lying position.

Part of the research, which focused on physical activity examined only the time allocated to various types of recreation, leisure and sports physical activities without the need to determine the intensity. Data were converted to an average quantitative profile of the physical activity of a particular individual, expressed in minutes of physical activity per week. According to previous authors, we specify the border between sufficient and insufficient physical activity set any value to 400 minutes of physical activity per week.

Motor skills testing

In the second part of the research, each participating person did several motor tests in a well-defined order. Key tests were those about balance abilities.

Static balance was measured using stabilometric platforms FITRO Sway (Bratislava, SVK) by standing in a natural position for 10 sec. Recording the length of the COP trajectory.

Static balance with the exclusion of the visual field was measured using a modified standing on one leg in a "flamingo" position, the free leg is supported on the standing leg in the ankle area. During the test, the tested person has closed eyes and we try to measure the number of attempts for achieving total time of 30 seconds. After each attempt the test person has a chance to relax and prepare again to the starting position.

As a test of dynamic balance was used walking backward at 10 cm wide beam in a distance 2.5 meters totally. The beam was placed at a height of 30 cm above the floor and measured the time required to walk backward movement.

In all tests tested persons had the possibility to use several attempts to warm up.

Statistical analyses

Results of the survey and motor tests were processed using Microsoft Office Excel 2007 (Microsoft, Redmond, WA, USA) for descriptive data and using 10.0 Statistica (StatSoft, Tulsa, OK, USA) for statistical analysis of the relationship between variables.

Individual test results were converted to standard T-score to facilitate the determination of the total final score and the overall result of the test persons was then calculated as the sum of the three individual results in Total T-score. Total T-score = $T_1 + T_2 + T_3$.

For each sub-factor were verified conditions of normal data distribution and homoskedasticity selections. Based on the condition of normality were determined suitable parametric methods. All calculations are done on the level of significance $\alpha = 0.05$.

Statistical methods, as stated Hendl (2006), in this work we use the analysis of the dependence of two quantitative variables using linear regression testing and parallelism of two regression lines.

In some results with the linear regression, we appeal to the slope of the regression line, whose gradient (slope) usually represents the rate of decrease of specific variables (level of skill) to age.

Results

After evaluating the questionnaires, we found that the median number of hours of physical activity interviewee of the adult population in the Czech Republic is 390.0 minutes per week, regardless of gender (women MED = 370.0, IQR= 430.0 and men MED = 390.0, IQR= 528.0).

We will focus on sufficient and insufficient amount of physical activity, which is a limit of 400 minutes per week. That limit based on work Fiala (2002) and Zvonař (2005) is higher than habitual recommendations (150 min moderate PA) because it doesn't accent intensity of PA. We find out that from the total number of 1171 respondents, 609 individuals did not exceed this limit. This represents just over half (52 %) of individuals with physical insufficiency in this population sample.

Most practiced physical activity was markedly dominated by walking, then cycling and fitness exercises.

To examine the relationship between balance abilities and physical activity we subsequently divided the tested sample by gender for men and women. Our decision divide group by gender based on previous studies of many authors. For all Hirtz (1982), Wolfson at al. (1993), Riegerová & Ulbrichtová (2006), Rival (2005), Punakallio (2003). Majority of the studies describe balance abilities differences in level and ontogenesis between men and women.

We performed a linear regression analysis and the calculation of linear regression was important to us as well as the regression line (results in Table 3.). It represents the slope of the decline in the ability to balance (motor tests results in the T-score) depending on age.

Tab. 3 Linear regression analysis – dependence Balance abilities T-score on age (basic results from Statistica®)

Regression analysis age vs. balance abilities				
	b*	b	p	n
women insufficient PA	-0.64	-1.55	< 0.01	48
women sufficient PA	-0.55	-1.07	< 0.01	57
men insufficient PA	-0.51	-1.01	0.05	15
men sufficient PA	-0.44	-0.64	< 0.01	42

We have audited the regression line congruence and parallelism in same-sex groups with sufficient and insufficient physical activity. We found no significant consensus or parallelism of regression lines for the group with sufficient and insufficient physical activity.

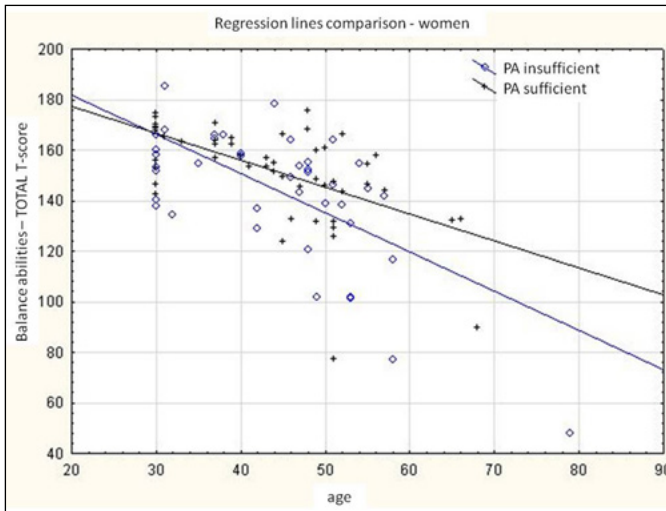


Fig. 1 Graphic depiction of regression lines – dependence Balance abilities T-score on age – women with sufficient and insufficient physical activity

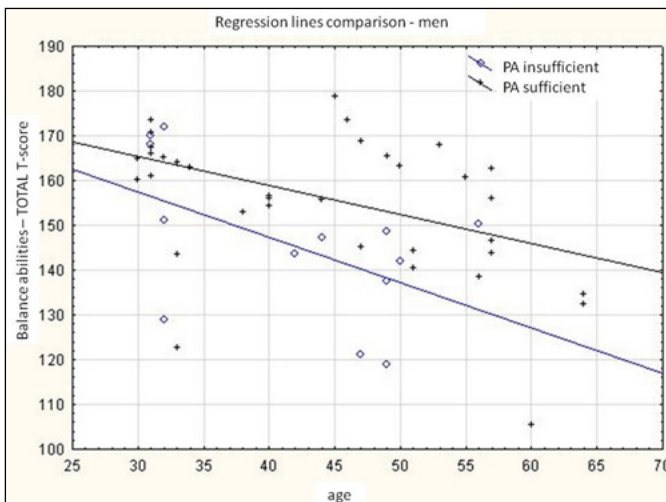


Fig. 2 Graphic depiction of regression lines – dependence Balance abilities T-score on age – men with sufficient and insufficient physical activity

This confirms the assumption that the decrease in the level of balance abilities is different in individuals with sufficient and insufficient physical activity. The numerical results and graphical output, it is clear that individuals with insufficient physical activity accelerates decline in balance abilities with age. This phenomenon occurs similarly in men and women.

Results of particular tests were similarly verified for balance abilities and there were no major differences compared to the overall results. The only test without significant difference was the static balance test with closed eyes measured in men's group.

Discussion

We know that physical activity is only one of a number of factors that can affect the balance abilities during ontogeny. That's why we are trying to prove that the relationship between physical activity and balance abilities is relevant demonstrable. This finding may add to the rich mosaic of already published information on the positive effects of physical activity on health aspects of human life (for example: (as a preventor pandemic of obesity, cardiovascular disease or orthopedic complications associated with hypokinesia).

Effect of physical activity on general coordination and specific skills of balance is also necessary to put in relation with the implementation of various intervention programs. Especially for post-productive period of age. It is necessary to emphasize the undeniable benefits of these programs is their generally positive impact on functional changes in the target group. On the other hand, it is necessary to objectively evaluate that despite the great benefits and socialization of these projects usually only a local effect on the population insignificant group.

In our study, we would like to draw attention to other proven positive aspect of physical activity. And not only in terms of human health but in an area that could have significant economic and social impact as well. Due to the planned extension of working life up to 70 years old people till 2050, this political decision could mean considerable difficulties in the employment of older individuals. For many professions is an adequate level of coordination abilities one of the main conditions of the possible employment of specific persons.

Older persons might be discriminated on the labor market significantly by greater involuntional changes at a later age ontogeny. A sufficient physical activity, as shown in our study, is one of the factors to keep that level as long as possible. We come again to the question of motivation, the level of government or employers, employees physical activity through leisure activities and access to certain benefits related for example to meet the recommended physical activity levels. Following and same complicated chapter remains how to objectively measure, whether at work or in leisure time, the physical activity.

Conclusions

Physical activity is generally considered one of the major factors affecting the health status of the population. In addition to this important benefit we have shown that physical activity is also a factor in the test group of 163 adults older than 30 years from Czech Republic positively influenced the level of balance abilities (as measured by the three motor tests) in relation to age.

This result suggests further positive effect of general physical activity, this time in coordination. Our findings open the door wider debate on the use of leisure time physical activity as a preventive measure restricting ontogenetically determinate loss of coordination skills.

Reference

- Fiala, J. Evaluace rizikových faktorů neinfekčních onemocnění pomocí komplexního vyšetření jako diagnostický a intervenční nástroj v primární prevenci. Brno, 377 p. MU.
- Hendl, J. Přehled statistických metod zpracování dat: analýza a metaanalýza dat. Vyd. 2., opr. Praha: Portál, 2006. 583 p.
- Hirtz, P. K charakteristice, diagnostice a ontogenetickému vývoji koordinačních schopností. In Měkota, K. a kol. 1982. Koordinační schopnosti a pohybové dovednosti. Praha: SPN, 1982.
- Koprivová, J., Jadvidžák, I., Funková, V., Stará, G. Uplatnění psychomotorických cvičení a her v pohybových aktivitách seniorů. 1. vyd. Olomouc: UP Olomouc, 2007. 6 p.
- Machovec, B. Vliv intervenčního pohybového programu na statickou a dynamickou rovnováhu a životní spokojenost seniorů. Brno, 2012. 102 p. MU.
- Punakallio, A. Balance abilities of different-aged workers in physically demanding Jobs. *Journal of Occupational Rehabilitation*. 2003, 13, p. 33-43.
- Riegerová, J., Ulbrichová, M. Aplikace fyzické antropologie v tělesné výchově a sportu. 2. ed. Olomouc: Vydavatelství UP, 1998. 147 p.
- Rival, C., Ceyte, H., Olivier, I. Developmental changes of static standing balance in children. *Neuroscience Letters*, 2005, 376(2), p. 133-136.
- Šrámková, P. Výzkum úrovně rovnováhových schopností a stavu posturální funkce u populace středního a staršího věku. Brno, 2012. 148. MU.
- Wolwson, L., Whipple, R., Judge, J., Amerman, P., Derby, C., King, M. Training balance and strength in the elderly to improve function. *Journal of the American Geriatrics Society*, 1993, 41, p. 341-343.
- Zvonař, M. Zdravotní stav, motorická výkonnost a rekreační pohybová aktivita populace středního staršího věku. Brno, 2005. 114 p. MU.
- Zvonař, M., Pavlík, J. Vývojové tendence motorických schopností střední a starší populace. *Sport a kvalita života*. Brno: Masarykova univerzita, 2005, p. 160.

Improvement of reaction time through the one semester course of table tennis for non-athlete students

Pavel Vacenovský, Tomáš Vencúrik

Faculty of Sport Studies, Masaryk University, Brno, Czech Republic

Abstract

The Aim of this research is to compare reaction time of students non-athletes in modified Agility test for Table Tennis after one semester course of Table Tennis. Thirty three men participated in our study (average 21.8 years, 178.2 cm, 77.1 kg), one group of eighteen students in autumn, another group of fifteen students in spring. We used modified Agility test for Table Tennis using Fitro Agility Check at the beginning of the semester (pre-test) and at the end of the semester (post-test) and compared dates. We have not proved statistically significant improvement of reaction time after one semester course of Table Tennis, although most of the students had improved. Average reaction time was 2.33 % better after one semester (1.76% when using hands, 2.85 % when using feet). We believe that course of Table Tennis is good choice for students, if they want to improve their reaction time, even we can not to prove it statistically.

Keywords: Reaction time, Table Tennis, non-athlete students, FiTRO Agility Check.

Introduction

Table tennis is one of the sport games, which is played not only by athletes, but is also very popular leisure time activity. Table tennis is played not only in the sport clubs, but also in hotels, recreation areas, even garages and of course in schools. At the Masaryk University there is big number of students interested in this game and usually only one third of them can attend classes of table tennis as a part of the physical education for capacity reasons. Training every week is for students beneficial in many ways.

Table tennis claims high demands on neuromuscular functions of organism and force players, in very short periods of time to react immediately to new occurred game situations. Speed of the ball and short distance it travels allows a minimal amount of time to react and execute a shot. That is why table tennis have been classified as reaction sport according to Yoshida et al. (1995). Good quality of reaction is close-knit with quick and proper motor activity. Velocity and reaction time are influenced by personal genotype, yet Šimonek (1989), Choutka (1981) found possibility to improve by 10-25% through training. Thus we decided to compare reaction time of students, non-athletes in modified Agility test for Table Tennis at the beginning and at the end of the semester course of the Physical education – Table Tennis.

Methods

Thirty three males participated in our study (average 21.8 years old, body high 178.2 cm and body weight 77.1 kg), one group of eighteen students in autumn semester and another group of fifteen students in spring semester. These students were amateur table tennis players without regular physical activity. Both semester courses consisted of 12 seminar sessions, each in duration of 90 minutes. Study plan was the same for both groups.

We applied modified agility test for table tennis using FiTRO Agility Check (FTVŠ UK, Bratislava, Slovakia) at the beginning of the semester (pre-test) and at the end of the semester (post-test) (Zemková, Hamar, 2009). Subjects started the test 0.75 m from the table. They had to touch as fast as possible (with feet or hands) one of the four mats, two of them were located on the floor under the table and the other two were located in the corners of the table (figure 1, figure 2). Width of the table was 1.525 m. Mats had to be touched in accordance with the location of the visual stimulus appearing in one of the corners of the screen. Disposition of mats was in accordance with a sport-specific tasks of the table tennis. Subjects had to touch the mats with the hand holding the racket, thus dominant hand and foot. Right-handers had to touch the mats with their right hand or right foot and left-handers with left hand or left foot. The test consisted of 16 visual stimuli (4 in each direction) with random generation of their localization and fixed time generation of 2000 ms. The test result is an average of the best reaction times (4 in each direction) in better of the two repetitions.

Acquired data was processed statistically using basic descriptive statistics and Shapiro-Wilk test of distribution normality. Data from the pre-test and post-test (reaction time of feet and the total reaction time) were compared using the dependent samples t-test. Data from the pre-test and post-test (reaction time of hands) were compared using Wilcoxon test. The statistical software Statistica 10 (StatSoft Inc., Tulsa, USA) was used for statistical calculations. Statistical significance was set at $p < 0.05$.

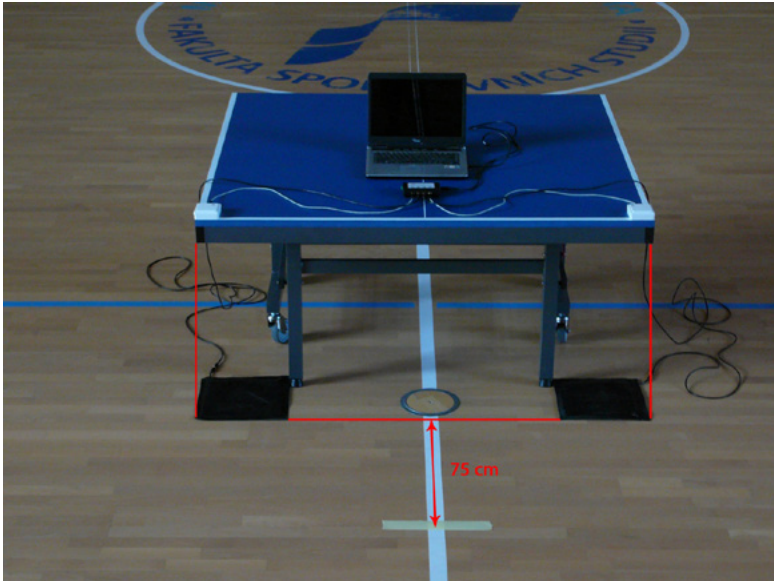


Fig. 1 Modified agility test for table tennis

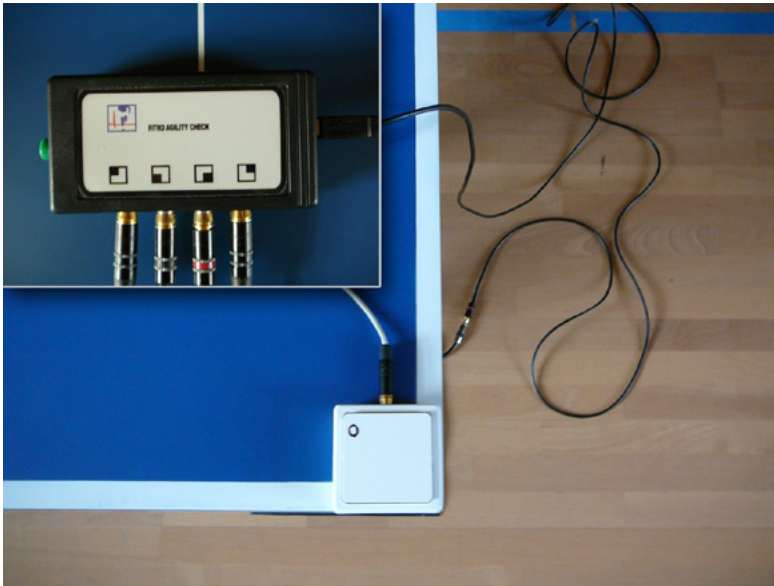


Fig. 2 Device FiTRO Agility Check

Results

Results of the modified test using Fitro Agility Check are presented in Table 1 (autumn semester) and Table 2 (spring semester). There we can find average reaction time in every direction at the beginning of the semester and at the end of the semester. Most of the participated students reached better results at the end of the semester. Average reaction time of all students was 1058.15 ± 191.42 ms at the beginning of the semester and 1033.52 ± 171.06 ms at the end of the semester, which is better by 24.62 ms (2.33%). We did not detect any statistically significant differences ($p > 0.05$) when total reaction time in pre-test and post-test was compared. Average reaction time in directions, where students had to use hands was 1019.79 ± 173.37 ms at the beginning of the semester and 1001.80 ± 156.67 ms at the end of the semester, which is better by 17.98 ms (1.76%). Average reaction time in directions, where students had to use feet was 1096.50 ± 201.03 ms at the beginning of the semester and 1065.25 ± 179.08 ms at the end of the semester, which is better by 31.26 ms (2.85%). None statistically significant differences were recorded between reaction times of hands in pre-test and post-test ($p > 0.05$) and neither were between reaction times of feet in pre-test and post-test ($p > 0.05$).

Tab. 1 Average reaction time of students in autumn semester

stud.	beginning of the semester					end of the semester				
	upper left	upper right	lower left	lower right	total avg	upper left	upper right	lower left	lower right	total avg
1	1205.5	1158	1144.5	1053.25	1140.31	1148	1105.5	1137	1009.5	1100
2	1127.25	1134.75	1243.5	1169.75	1168.81	979.75	1065.75	1023	1068.25	1034.19
3	1048.5	1041.75	1139	1079.25	1077.13	960	953.75	1037.75	992.25	985.938
4	943.25	985.5	1139.25	1111.25	1044.81	1013	1027.5	1293	1128	1115.38
5	917	955.25	1014.75	983	967.5	802	891	878.75	832	850.938
6	976	1154.5	1324.5	1247.5	1175.63	1039.25	1107.5	1133.25	1121.25	1100.31
7	1065	1000.75	1154.75	1063	1070.88	1254.5	1168.5	1255.5	1244.5	1230.75
8	1210.5	936.25	1490.5	1252.5	1222.44	894.25	977.75	1005.25	1258	1033.81
9	971.5	969.5	1138.75	1127.75	1051.88	976	1023	1134	1148	1070.25
10	1157	1222.75	1238	1085.25	1175.75	1198.75	1054.75	1249.25	1121.5	1156.06
11	989.75	1021	977.25	920.25	977.063	936.5	835.5	1057.75	983	953.188
12	1154.5	974.25	1138.25	1256	1130.75	1233.75	1258.5	1247	1136.5	1218.94
13	1172.25	1127.5	1273.5	1231.25	1201.13	1238.5	1147.5	1212.5	1078	1169.13
14	955.5	1245.5	1283.5	1005.25	1122.44	929	1028	1051.25	1052	1015.06
15	1151	743.75	937.25	846.75	919.688	827.75	927.75	907	1026.75	922.313
16	980	1055.75	1129.25	1197	1090.5	982	1004	957	895	959.5
17	970.75	951.5	1132.75	1086.75	1035.44	998	1097.75	1133.75	1114	1085.88
18	930.75	844.75	1082.75	1099.75	989.5	873.75	823.5	928.75	867.25	873.313
all stud.	1051.44	1029.06	1165.67	1100.86	1086.76	1015.82	1027.64	1091.21	1059.76	1048.61

Tab. 2 Average reaction time of students in spring semester

stud.	beginning of the semester					end of the semester				
	upper left	upper right	lower left	lower right	total avg	upper left	upper right	lower left	lower right	total avg
19	1153.75	1031	1250	1160.25	1148.75	979.75	997.25	1188.25	1124	1072.31
20	1049.25	905.25	1230	1132.75	1079.31	927.75	888.5	1002.75	910.25	932.313
21	997.25	916.25	1114	930.25	989.438	995.25	947.5	1043.25	885.75	967.938
22	797.75	750.5	845.75	814.5	802.125	851	801	894.75	837	845.938
23	928.75	1037.25	853.25	1055.75	968.75	928.75	954.5	951.25	1018	963.125
24	1086.25	986.5	1164.75	1048.75	1071.56	908	876	970.75	907.5	915.563
25	1226.25	1364.75	1241	1455.25	1321.81	1281.5	1144	1309.75	1257	1248.06
26	1015.25	842	1018	815.75	922.75	1082.75	955.5	1158.5	975.75	1043.13
27	1033.75	928.25	958.5	956.5	969.25	1112	973.25	971.25	921.75	994.563
28	918.75	920.75	1017.75	879.25	934.125	856.75	882.75	1029.75	883.25	913.125
29	1006	974	969.75	1229.25	1044.75	908	837	1077.75	966.25	947.25
30	874.5	890.25	977.5	840	895.563	893.75	854.25	1022.75	907	919.438
31	1053.75	961	1113.25	1008.25	1034.06	1013.75	974.5	1071	1011.5	1017.69
32	1361	1106	1233	1182.75	1220.69	1194.25	1230.5	1416.5	1272.75	1278.5
33	892.75	848.25	1115.75	960.25	954.25	1162.75	924.25	1365.5	1237.25	1172.44
all stud.	1026.33	964.133	1073.48	1031.3	1023.81	1006.4	949.383	1098.25	1007.67	1015.43

Discussion

The results show that regular training can improve the level of visual reaction time, which corresponds with the results of the study Vidja et al. (2012), which states that the longer players play table tennis, better visual reaction time they have. Testing conducted also Strešková (2002). Her study provides a comparison of table tennis and other sports. Table tennis players achieve the best reaction time (agility test using Fitro agility check). However, both these studies focused on players who have trained for a long time, while our student trained for only 12 weeks. Greater improvement in the directions when they had use feet can be explained, that the students improved

technique and better total locomotion contributed to better results. Many factors can influence the results. Increased rate of fatigue and impaired the ability to focus is one of them, although students did not admit that when asked.

Conclusion

We have been pleased, that our modified test proved to be usable. The results showed that many students have improved. On the basis of these results, the above studies and our own experience we think, that course of Table Tennis is good choice for students, if they want to improve their reaction time, even we can not to prove it statistically. We also believe that table tennis is suitable physical activity not only for students. This sport is one of the sport games suitable even for some seniors and better visual reaction time can help them in their everyday life. We recommend deeper study of this problem.

References

Choutka, M. (1981). Sportovní výkon. Praha, Olympia.

Strešková, E. (2002). Prínos zisťovania disjunktívnych reakčno-rýchlostných schopností v stolnom tenise. Acta Facultatis Educationis Physicae Universitatis Comenianae, 43, 147-151.

Šimonek, J. ml. (1998). Hodnotenie a rozvoj koordinačných schopností 10-17 ročných športovcov. Nitra, Univerzita Konštantína Filozofa.

Vidja, K., Dodhia, S., Bhabhor, M., Bhanderi, P., Chudasama, J., Jani, H. (2012). Long Term Playing of Table Tennis Improve the Visual Reaction Time. International Journal of Scientific Research, 1(6), Retrieved from <http://theglobaljournals.com/ijsr/file.php?val=Mjgy>

Yoshida, K., Hiruta, S., Shimaoka, M., K., F., Ilmoto, Y., & Yuza, N. (1995). A study on spin control techniques for chop and float services in table tennis. Proceedings FISU/ CESU Conference: The 18th Universiade 1995 Fukuoka, Japan.

Zemková, E., Hamar, D. (2009). Toward an Understanding of Agility Performance. Czech Republic: František Šalé – Albert. ISBN 978-80-7326-168-9.

**SAFETY IN PHYSICAL EDUCATION,
SPORT AND LEISURE ACTIVITIES**

The traditional art of swordsmanship and its application today. A case study of one of the Japanese schools

Wojciech J. Cynarski

Faculty of Physical Education, University of Rzeszow, Rzeszów, Poland

Abstract

The study concerns the historic form of fencing, especially the Japanese kenjutsu Tenshin Shoden Katori Shinto-ryu school, in its contemporary reception in Central Europe. The area of research is Poland, with references to other European countries. The scope of research determines the turning point – the year of 1987, when arose the first training contact with a competent instructor of this school. That is the period from 1987 to 2013. In the perspective of sociology and humanistic theory of martial arts, it was addressed: 1) Today's reception of ancient martial arts, 2) cultural conditions of their practice (past and present), 3) selected psycho-social conditions of their current cultivation, 4) current operation (as it manifests itself), the processes of change (if there) and institutionalization. The main method used here is long-term participant observation and practical long-term studies of discussed here martial arts (26 years). The author has been observing the socio-cultural contexts of martial arts' environment, today reception and adaptations (changes) of fencing arts, the channels of communication and the process of institutionalization, as well as a preference for training reasons. He practiced traditional fencing in Europe and Japan. He achieved master's degrees in iaido, kenjutsu and kobudo with several organizations, and licenses authorizing the teaching and examination (French, Japanese, Polish, German and international). Author pursued studies of the Old-Japanese fencing such as in the Cercle de Research d' Aiki-et Kobodó in France (3-month internship scientific research and methodological training). Then, in the Shibu Kobudo in France and Poland, the Commission of Fencing by Idokan Poland Association, and in other institutions. He participated in the development of institutional and modern history of Japanese kenjutsu in Europe, as a student and later a teacher and activist, and as a researcher. Also resorted to other qualitative methods as analysis of the literature and hermeneutic analysis of the expression of martial arts experts. These statements were quoted by specialized magazines, such as "Karate – KungFu", "Samurai", "Wojownik" (Warrior). In many cases, these were the direct relationship, or a description of the facts known to the author of the autopsy. In the interpretation of the described facts the Maffesoli's idea of neotribalism were used and theory of cultural dialogues by Eliade-Tokarski. It was found that the movement of students of the Katori Shinto-ryu school is still in Poland (in its large part) a form of neotribe.

It is an expression of cultural dialogue, which specific factors and manifestation are the historical fencing and old schools of martial arts (kobudo ryuha). The main lines of transmission indicated the school curriculum, the dominant forms of promotion and attention of institutional development were described. Pointed to the fact that despite the loss of a strictly utilitarian value, possession of a white weapon is in this day and age still attractive. This depends on the specific recreational values of the traditional fencing art. These include improving the efficiency and capacity of health, an increased sense of security, the implementation of cognitive needs, self-expressional and aesthetic.

Keywords: *fencing, kenjutsu, katori shinto-ryu, transmission of tradition, recreational values.*

Introduction

It is not on sport fencing, but about the historic and utilitarian one. Generally, we say in this instance on using weapons according the tradition from central Japan specified as nihonden kobudo. In case of schools, where the leading weapon is the sword, actually a Japanese sabre uchigatana, we think on martial art kenjutsu. This “art of sword” include the fencing walking and riding, bringing out the sword iaido (literally, ‘the way of harmony’), the use of the sword battojutsu, and using different blades –from the knife after a great sword. A related art is the naginatajutsu (glaive techniques), derivative one – sport kendo. When a school teaches classical martial arts, including a variety of weapons, especially the famous samurai sword, we can talk on kenjutsu, kobudo or kobujutsu [Finn 1982; Cynarski 2004]. Such is the case of the fifteenth-century school katori shinto-ryu.

The theoretical perspective for the reflection gives here: sociology of martial arts and area of the martial arts science. Particularly, among the issues sociology of martial arts interesting here are the following: 1) today’s reception of ancient martial arts, 2) cultural conditions of their practice (past and present), 3) psycho-social conditions of their current cultivation, 4) current operation (as it manifests), the processes of change and institutionalization [Wacquant 2006; Cynarski 2012]. Reception and internalization of martial arts’ values were comparatively studied in Europe and the U.S. In particular, the practice of traditional martial arts schools is related to the social reception of the film, martial arts and samurai cinema [Cynarski, Berdel 2003]. The ethos of the knights and warriors is usually (though not entirely) by practicing internalized. The concept of neotribalism will be used for interpretation of the described facts [Maffesoli 1996]. These are communities of people whose sense of community and identity emerges not as a result of a joint education or residence, but by common interests, leisure,

common ideas or ideals. Members of neotribals remain in contact with each other only occasionally spatial. They have, however, a sense of community and some cultural ties. They integrate regardless of nationality or race, age, sex, education and occupation, e.g. through the Internet and other new media.

Socio-cultural origin and development of martial arts in the literature have been fairly well described [Draeger 1973; Ratti, Westbrook 1991; Jones 2002]. Less represents a sphere explication of such conditions and relations of the present system of stratification groups of martial artists. And among psychosocial conditions seem especially important needs and motivations of people exercising. A desire to get traditional fencing combat skills for self-defense could be even more dominant in the recent past. Today it is practiced recreationally for pleasure and health, or for aesthetic [cf. Clément 1995; Cynarski, Obodyński 2006]. Interesting will be here the lines of communication, maintaining or changing the content of teaching and the organizational and institutional development. On the other hand, to describe the martial arts, their teaching and practice, we look to the concept of the theory of martial arts [Cynarski 2000, 2013].

The main method used here is participant observation with extensive practical experience of the last 26 years. Author has included B. Malinowski's method the establishment of specialized research methodology martial arts. Author participated in the development of institutional and modern history of kenjutsu in Europe, as a student, teacher and activist.

Characteristics of the tenshin shōden katori shintō-ryū

Master of martial arts Iizasa Chōisai Ienao (1387–1488) founded tenshin shōden katori shintō-ryū (“fighting traditions which follow the way of gods”) around 1447 [Lind 1999: 232]. The school is for centuries famous of kenjutsu, but also bōjutsu (long stick techniques) and naginata (glaive). It is characterized by a rich repertoire of techniques, dynamics of practiced forms and the use of a wide range of weaponry. However, the sword remains the central weapon. Up today, kenjutsu techniques and forms are being used – sword fencing, also with the use of shorter sword and two at the same time, as well as iai – the art of drawing the sword and cutting. Japanese martial arts historians enumerate the skills that this school teaches: bōjutsu, iaijutsu, tachi-ai battōjutsu (cutting exercises), naginatajutsu, sōjutsu (spear), jūjutsu etc. [Otake 1977; Sugino, Ito 2013]. Old schools (ryū-ha) presents mostly a historical value, what is especially valuable for the connoisseur. Only some of them are not teaching ritualized forms, for instance katori shintō-ryū, technique of which remained as effective as medieval battlefield.

Paired kenjutsu forms master the sense of distance, timing, rhythm while improving precision, strength and speed. Teacher (uke-dachi) assesses a student (kiri-komi) with

reprimands for mistakes in form of light strikes. Kenjutsu teaches methods of attack on arteries, wrists, neck; the whole body is attacked with the use of various techniques in diverse directions and surfaces of directing weapons. Technical abilities are supported by general excellent body condition, which enables not only speed and quick reflexes but also e.g. jumping above naginata. Forms made in pairs make it possible to concentrate and relax, expression and appropriate exercise. In addition, a man enrich aesthetic experiences. At the advanced level choreography resembles a battle scene – samurai duel. Methods are, however, mainly meaning schooling: bring in the possibility of situational application techniques and their combination in system “weapon against weapon.”

Quarter of a century the kenjutsu katori shintō-ryū school in Poland

Although the descriptions of the history of traditional Asian fencing and her practice in Poland have been published, but in previous publications were some inaccuracies. We are talking for example, the date of appointment Shibu Kobudō by Idōkan Poland Association (IPA) and some other facts [cf. Cynarski, Szajna 2012].

First came to Poland only books by shihan Otake Ritsuke and Draeger, and samurai movies where shihan Sugino Yoshio realized choreographed fight scenes. Some instructors of martial arts circles trying to practice the kenjutsu, usually quite clumsy. It was like the beginnings of karate while trying to learn from books. In 1987, Stanislaw Cynarski (judo and jujutsu instructor from Tarnow) made \$\$ contact with the French expert Alain Floquet, a student of masters Minoru Mochizuki, Yoshio Sugino and Tokimune Takeda. Sensei Lionel Lefranc was the first instructor, addressed to Poland by Floquet, who demonstrated a number of techniques and forms of school katori shintō-ryū (Tarnow, summer 1988). The first who taught the technical basis of the sword of the school in Poland, was in turn Laurent Chaigneau (1989). Teaching these traditional forms took place under the aikibudō/kobudō master Floquet having the 6 dan in katori shintō-ryū. School of Yoshio Sugino (hanshi, 10th dan) was then represented in Europe by Shibu European and Francophone Countries, based in France, which Floquet managed for some time to maintain despite the objections of the Dutch and the Italians.

It was in France, during multiple visits, where Polish students of medieval Japanese swordsmanship learned including under the direction of Gorō Hatakeyama (hanshi, 9 dan) and age Yoshio Sugino. In the face of GM Sugino in 1992, W. J. Cynarski passed with 1st kyu, a year later in the face Hatakeyama and Floquet – the 1st dan. It was the first such degrees in Poland and in this part of Europe.

In 1993 W. J. Cynarski held in Warsaw, the first in Poland aikibudō/kobudō instructor course under auspices of the Polska Federacja Dalekowschodnich Sztuk Walki (Polish Martial Arts Federation). Organizationally, katori shintō-ryū placed at the Centre

Aikibudō and Kobudō in Poland, which has adopted the name of the Polish Union Kobudō and Aikibudō. The first president and organizer of international seminars in Tarnow was S. Cynarski. Then take care of the art of Katori Shinto temple took over the technical committees at IPA and by Polish AikiBudō and KoBuJutsu Federation, headed by W. J. Cynarski. For some time (years 1993-1995) the movement aikibudo/kobudo in Poland competed divided into centres in Tarnow and Rzeszow. This was the right way, that competition cheering for promotional activities (trainings, presentations, publications). But while aikibudō of Floquet kyōshi declined in Poland, kobudō katori shintō-ryū still functioned, especially by IPA in Rzeszów. In early January 1999 hanshi Hatakeyama sent to W. J. Cynarski official license of the school which authorizes teaching. Shibu Tenshin Shoden Katori Shinto-ryu in Poland at the Rzeszów Centre Dōjō Budōkan (central centre of the IPA) was then formally announced. This opened a new chapter in Polish and European history of the ancient Japanese martial art.

Teaching in the lineage shihan Otake is in Poland so far absent. In line M. Mochizuki, a modified form of yoseikan shinto-ryu, students could explore during the international training in France. However, the original line of shihan Yoshio Sugino teaching has been preserved in Rzeszow Shibu. The younger generation of instructors collaborated in recent years with the master Hatakeyama, which slightly changed the kata execution. However, because the teaching is not gained acceptance 20th sōke Iizasa Shuri-no-suke Yasusada (heir of the tradition), probably all go back to the original version. Today keeps it shihan Yukihiro Sugino 9 dan – son of master-teacher Yoshio Sugino.

Among the forms of promotion should be mentioned numerous shows, made back in the 1990s by W. J. Cynarski as in Hotel Marriott (Warsaw), in Centennial Hall (Wroclaw), when by the First Polish Championships in Jujutsu (Jaworzno), the 650th anniversary of Rzeszow (town square) and others. This instructor taught the basics of this martial art in many places in Poland, Germany and Romania. And in Tarnow next international seminars held at the invitation of S. Cynarski. Belgian instructor Jan Janssens, a 1st dan degree holder in this school, was the teacher.

Probably the most interesting and most important event for the promotion of the katori shintō-ryū school, was a fighting demonstration: samurai sword against hussar sabre. The initiator of the duel was Professor Wojciech Zabłocki, Grand Master of the historical school of swordsmanship, and earlier multiple Olympian in sport sabre. W. J. Cynarski took the challenge. There has therefore to confront the sharp weapon. It was in November 1992, in “Tsubame”, Japanese restaurant in Warsaw [Zabłocki 2011: 34]. The fight broadcast on Polish TV. So Cynarski represented kenjutsu katori shintō-ryū against traditional Polish hussar sabre fencing art of Zabłocki. Later, they were recording W. J. Cynarski and Shibu Kobudo for satellite stations RTL7 and TVN Turbo, too.

Currently, the dominant form of promotion of the arts is the Internet. Young instructors from several centres and other stakeholders to communicate in this way, specific to the 'new tribes'. These people work outside the Shibu without creating any formal organizational structure. They already have a strong track record – keeping a relatively fixed number of instructional groups, regular seminars and achieve a high level of skill. There are Hatakeyama's students: Jacek Krzeszowiec (Lublin), Mateusz Kuduk (Kraków) and Rafał Sołapski (Warsaw). Still active is sensei S. Cynarski, too (Tarnów). Success is especially organizing international seminars with participants from these centres and Shibu – in Mszana Lower (summer 2011) and Krakow (December 2012). In the first case, the training was conducted by Sergio Mor-Stabilini (7 dan, menkyō okuden). In the second – another Italian student of Hatakeyama – Andrea Ré (7 dan). Both seminars was organized by M. Kuduk. The Polish Shibu Kobudo joined although S. Mor-Stabilini, but the all movement is still (in its large part) neotribal form.

Conclusions

The movement of students of the kenjutsu school katori shintō-ryū is still in Poland (in its large part) a neotribal form. Perhaps the future organization of the samurai tradition lovers to be similar to that described above. That is less formality and no centralization. Only the parties involved on the basis of communication and a voluntary basis. May be, that the environment is ripe for a statement (and decision) that compliance with certain rules of conduct gives in return more organizational capabilities.

The organization is still far less advanced. Despite the loss of a strictly utilitarian value, possession of a white weapon is in this day and age still attractive. Special recreational values of traditional fencing are crucial here.

References

- Clément J. P. (1995), Contributions of the sociology of Pierre Bourdieu to the sociology of sport, "Sociology of Sport Journal" 12, pp. 147-157.
- Cynarski W. J. (2000), Methodology of martial arts research, „Idō – Ruch dla Kultury/Movement for Culture”, vol. 1, pp. 46-53.
- Cynarski W. J. (2004), On art of fencing, „Idō – Ruch dla Kultury/Movement for Culture”, vol. 4, pp. 29-42. ISSN 1730-2064.
- Cynarski W. J. (2012), Martial Arts Phenomenon – Research and Multidisciplinary Interpretation, Rzeszow University Press, Rzeszów, pp. 242. ISBN 978-83-7338-772-0.
- Cynarski W. J. (2013), Budo, martial arts and combat sports – definitions, ideas, theories, "Research Journal of Budo" 45(3), pp. 222-241.
- Cynarski W. J., Berdel B. (2003), Ethics in the martial arts film, „Acta Asiatica Varsoviensia”, Polish Academy of Sciences, no. 16, pp. 7-18. PL ISSN 0860-6102.
- Cynarski W. J., Obodyński K. (2006), The samurai way – recreation with classical white weapon [in:] Z. Borysiuk [ed.], Movement and Health. 5th International Conference Proceedings, Głuchołazy, 17-18 Nov., Opole, pp. 263-268. ISBN 83-60691-05-3.
- Cynarski W. J., Szajna G. (2012), Japanese fencing art kenjutsu in Poland (1987-2012) with particular emphasis on Podkarpacie [in:] W.J. Cynarski [ed.], Martial arts phenomenon research and multidisciplinary interpretation, UR, Rzeszów, pp. 161-193.
- Draeger D. F. (1973), The Martial Arts and Ways of Japan (vol. 1-3). Modern Bujutsu & Budo, Weatherhill, New York-Tokyo.
- Finn M. (1982), Iaido. The way of the sword, P.H. Crompton Ltd., London.
- Jones D. E. [eds.] (2002), Combat, Ritual and Performance. Anthropology of the Martial Arts, Praeger, Westport, Connecticut – London.
- Lind W. (1999), Das Lexikon der Kampfkünste, Sportverlag Berlin.

Maffesoli M. (1996), *Times of the tribes. The decline of individualism in mass society*, Sage, London.

Otake R. (1977), *The Deity and the Sword. Katori Shintō Ryū (vol. 1)*, Minato Research & Publishing Company, Tokyo. (Mukei Bunkazai Katori Shinto-ryu).

Ratti O., Westbrook A. (1991), *Secrets of the samurai; A survey of the martial arts of feudal Japan*, Tuttle Publishing, Tokyo.

Sugino Y., Ito K. (2013), *Tenshin Shoden Katori Shinto Ryu Budo Kyohan*, Demond GmbH.

Wacquant L. (2006), *Body and soul: notebooks of an apprentice boxer*, Oxford University.

Zabłocki W. (2011), *Szable świata*, Bosz Bellona, Warszawa.

Cerebral Concussions in Young and Adult Athletes: Epidemiology and Mechanisms

Willy Pieter

College of Physical Education, Keimyung University, Daegu, Korea

Abstract

The purpose of this study was to review the available literature on selected contact sports relative to the epidemiology of head injuries and their mechanisms. High school male ice hockey players recorded a concussion rate of 3.6/1000 A-E (95% CI: 1.0-9.3). High school soccer players had a concussion rate of 0.18/1000 AE, 95% CI: 0.14-0.22). In taekwondo, men (9.4/1000 A-E, 95% CI 7.1-11.7) were at a higher risk than women (4.6/1000 A-E, 95% CI 2.6-6.5) of incurring cerebral concussions (RR=1.9, 95% CI: 1.1-3.4). Boxing had the highest incidence of concussion in professionals (0.8 per 10 rounds, 95% CI: 0.75-0.95) and amateurs (7.9 per 1000 athlete-minutes, 95% CI: 5.45-11.09). In American football, the top of the helmet recorded the greatest peak linear acceleration 72.4 g. In taekwondo, the greatest peak linear acceleration was by the roundhouse kick: 130.11g. Depending on the taekwondo helmet type, the largest peak acceleration was to the right side: 187.69±53.04g (95% CI: 96.60-250.98g). Preventative measures are urgently needed in contact sports to help reduce serious head injuries in both young and adult athletes.

Keywords: *concussion, contact sports, adult, young.*

Introduction

Head injuries, such as cerebral concussions, in contact sports are a major cause of concern for all those involved. This is especially the case when dealing with young athletes in view of their still growing brains. Powell and Barber-Foss (1999) indicated that 63.4% of all injuries occurred in American football, followed by wrestling (10.5%), girls' football (soccer, 6.2%) and boys' football (soccer) with 5.7%. During the 1996-1999 seasons, high school boys in American football sustained a concussion rate of 33.09/1,000 athlete-exposures (A-E) (95% CI: 24.74-41.44) (Schulz et al., 2004). Halstead et al. (2010) found cerebral concussions to range from 0.47-1.03/1,000 A-E in high school American football players, followed by a rate of 0.36/1,000 A-E in girls' football (soccer).

The concussion rate in young taekwondo athletes was 21.9/1,000 A-E, 95% CI: 18.9-24.9) for boys and 22.2/1,000 A-E (95% CI: 17.2-27.2) for girls (Pieter, 2009). The first

time the exact injury mechanisms in taekwondo were published, it was revealed that the unblocked roundhouse kick in the men and the unblocked spinning back kick in the women led to concussions (Pieter et al., 1995). Subsequent research also showed the axe kick to be involved in concussions (Koh and Watkinson, 2002). The purpose of this study, then, was to review the available literature on selected contact sports relative to the epidemiology of head injuries in competitions and their mechanisms.

Methods

Participants

The subjects of this study consisted of young and adult athletes engaged in American football, boxing, and taekwondo.

Materials and Procedure

A computer search was done using the following keywords: injuries, boxing, American football, combat sports, taekwondo, martial arts and injuries. The second stage of the search involved screening the literature for the methods used, i.e., mainly prospective injury studies were selected. Finally, selected biomechanical factors suggested to be related to concussion will be summarized.

Results

According to the National High School Sports-Related Injury Surveillance Study, USA, 2005-2010, the American football competition concussion rate was 174.7/100,000 A-E with a recurrent rate of 23.7/100,000 A-E. The injury mechanism was contact with another player. The rate ratio was 8.58/100,000 A-E (95 % CI: 6.23-11.81) (Castile et al., 2011). Rate ratio is defined as (Castile et al. 2011):

the number of competition recurrent concussions/the number of competition A-E divided by the number of practice recurrent concussions/the number of practice A-E.

Zemper (2003) conducted a 2-year study on cerebral concussions in American high school and college football players. He found that the relative risk of incurring a concussion for high school players with a previous history of the injury compared to those with no history of concussion was 6.6 (95 % CI = 5.0-8.8). At the college level, the risk was 5.3 (95 % CI = 4.3-6.6), which was not significantly different from that of their younger counterparts.

Bledsoe et al. (2005) observed 1.7 injuries/100 matches in professional boxers, or 3.4 injuries/100 rounds. According to Tommasone and Valovich-McLeod (2006), professional boxers sustained the highest incidence of concussion (0.8 per 10 rounds,

95 % CI: 0.75-0.95) as well as at the amateur level (7.9 per 1000 athlete-minutes, 95 % CI: 5.45-11.09). Loosemore et al. (2008) concluded that, based on their review, chronic traumatic brain injury in amateur boxers is not as big an issue as it is in their professional counterparts. Although exposure data are not available, Potter et al. (2011) estimated that 165,602 people (95 % CI: 134,891-196,313) sustained boxing injuries for which they had to go to hospital emergency departments in the US between 1990 and 2008.

The concussion injury rate for adult taekwondo males varied from 1.0/1,000 A-E (95 % CI: 0.9-2.9) to 55.2/1,000 A-E (95 % CI: 27.2-83.1) in men and 3.2/1,000 A-E (95 % CI: 3.1-9.6) to 49.3/1,000 A-E (95 % CI: 12.8-85.8) in women. Men (9.4/1,000 A-E, 95 % CI: 7.1-11.7) were at a higher risk than women (4.6/1000 A-E, 95 % CI: 2.6-6.5) of incurring cerebral concussions (RR=1.9, 95 % CI: 1.1-3.4). The roundhouse kick, a rotational technique, was most often implicated in injuries, especially cerebral concussions. The spinning back kick, a combination of a rotational and translational technique, was the second most frequent cause of injury (Pieter et al., 2012).

When comparing young and older taekwondo athletes in terms of concussion risk, Koh and Cassidy (2004) found that in a combined sample of boys and girls, middle school taekwondo athletes (14 years) were at a higher risk of receiving a head blow (OR=2.2, 95 % CI: 1.7-2.8) and to incur a concussion (OR=1.9, 95 % CI: 1.4-2.6) compared to their high school counterparts (17 years). Regardless of age, those who used blocking skills were less likely to receive a head blow in competition (OR=0.7, 95 % CI: 0.5-0.9) or sustain a concussion (OR=0.6, 95 % CI: 0.4-0.9).

Discussion

At the 2012 London Olympic Games, the risk of incurring an injury was highest in taekwondo for men (RR=1.9, 95 % CI: 1.1-3.5) as well as in football (soccer), BMX and mountain biking. For women, it was in football (soccer): (RR=1.7, 95 % CI: 1.2-2.2) (Engebretsen et al., 2013). Taekwondo and football (soccer) also sustained most of the injuries at the 2008 Olympic Games: 34 injuries for 27 % of registered taekwondo athletes with 16.2 % of them incurring time-loss injuries. Other sports at high risk included hockey, handball, weightlifting, and boxing: all of them had ≥ 15 % of the athletes being injured (Junge et al., 2009).

Although exposure data are not available, it is of great concern that the percentage of concussions in boxing registered to US emergency departments in those aged 12-17 years (8.9 %) was similar to that in their counterparts aged 18-24 years (8.1 %) and those aged 25-34 years (8.5 %) (Potter et al., 2011). When compared with other individual male sports (karate and taekwondo), boxing had the highest incidence of concussions in professional (0.8 per 10 rounds, 95 % CI: 0.75-0.95) and amateur athletes (7.9 per

1000 athlete-minutes, 95 % CI: 5.45-11.09) (Tommasone and Valovich-McLeod, 2006). Zazryn et al. (2006) reported an injury rate of 1221.4/1,000 hours of competition for amateurs and 1081.1/1000 hours of competition for professionals.

In Canadian young taekwondo athletes, boys and girls aged 13 years or younger as well as girls 14-17 years old did not incur any cerebral concussions. Boys in the older age group sustained a concussion injury rate of 11.0/1,000 A-E (95 % CI: 4.2-26.2) (Pieter and Kazemi, 2007). Castile et al. (2011) found the injury rate for new competition concussions in American football for high school boys between 2005 and 2010 to be 174.7/100,000 A-E with a recurrent rate of 23.7/100,000 A-E. The rate ratio (RR) was 8.58/100,000 A-E (95 % CI: 6.23-11.81). In high school girls engaged in football (soccer), the rate for new concussions was 73.5/100,000 A-E with the recurrent rate being 12.0/100,000 A-E. The RR was 17.02/100,000 A-E (95 % CI: 5.98-48.42).

At the 2008 Olympic Games in Beijing, an estimated 8.1 % of boxers had a time-loss injury, while 94.7 % of all injuries were incurred during competition (Junge et al. (2009). At the 2012 Olympic Games, 9.2% of boxers had a time-loss injury with 72.2 % of all injuries sustained in competition (Engebretsen et al. (2013).

Taekwondo recorded 27 % of all athletes to have time-loss injuries with 64 % of total injuries occurring during Olympic competition (Junge et al., 2009). At the Olympic Games in London (2012), 15-39 % of all athletes in taekwondo, football, BMX, handball, mountain bike, hockey, weightlifting, athletics and badminton reported an injury (Engebretsen et al. (2013). At the same Games, 0.4 % of total injuries in all sports led to a time loss of >7 days. In taekwondo, this was 5.5 % compared to 4.2 % in BMX and 0.4 % in boxing. In team handball, it was 4.6 % and in football (soccer), 2.2 % (Engebretsen et al., 2013).

Beis et al. (2007) found Greek older boys (14-17 years) to be at a higher risk of sustaining concussions when compared to their younger counterparts (11-13 years): OR=7.9 (95 % CI: 0.9-67.6). This difference did not change when boys and girls from the same age group were combined as was done by Koh and Cassidy (2004): the older children in Beis et al.'s study were still at a higher risk of sustaining a cerebral concussion (OR=6.0, 95 % CI: 1.1-34.3). However, based on the confidence intervals, the difference may not be as straight forward as the point estimate seems to suggest. Beis et al. (2007) found time lost following a concussion in men \geq 18 years (0.98/1,000 A-E, 95 % CI: 0.94-2.90).

The linear, rotational and combined forces on boxing and mixed martial arts (MMA) padding were investigated by Bartsch et al. (2012) using low (27-29 J) and high (54-58 J) energy aimed at the lateral side of the head of a Hybrid III 50th percentile ATD (Humanetics Innovative Solutions). The impacts were done to simulate hook punches. The conditions were: unpadding (control), MMA glove-unpadding head,

boxing glove-unpadded head, unpadded pendulum-boxing headgear, and boxing glove-boxing headgear. The low energy linear head accelerations were 153.0g (control), 54.7g (pendulum headgear), 62.0g (boxing glove bare head) and 54.7g (glove, bare head). For the high energy condition, the values were 232g (control), 129g (unpadded pendulum headgear), 117g (MMA glove bare head), 144g (boxing glove bare head) and 65g (boxing glove headgear).

Peak linear acceleration at the front of American football helmets varied from 64.6 ± 1.9 g to 65.5 ± 3.0 g, depending on the helmet model. Also depending on the model, impacts to the side of the helmet, varied from 66.4 ± 2.5 g to 80.0 ± 1.3 g (Post et al., 2012).

O'Sullivan et al. (2013) tested helmets approved by the World Taekwondo Federation (WTF). Depending on the helmet type, the largest linear peak acceleration was to the right side: 187.69 ± 53.04 g (95 % CI: 96.60-250.98g). The conclusion was that all helmets tested did not meet the ASTM standards, regardless of which side of the helmets was impacted. The authors recommended that taekwondo headgear manufacturers and governing bodies must consider improving the design of all helmets.

Conclusion

Preventative measures are urgently needed in contact sports to help reduce serious head injuries in both young and adult athletes.

References

- Bartsch, A. J., Benzel, E. C., Miele, V. J., Morr, D. R. and Prakash, V. (2012), Boxing and mixed martial arts: preliminary traumatic neuromechanical injury risk analyses from laboratory impact dosage data, *Journal of Neurosurgery*.
- Beis, K., Pieter, W. and Abatzides, G. (2007), Taekwondo techniques and competition characteristics involved in time-loss injuries, *Journal of Sports Science and Medicine*, 6, *Combat Sports Issue 2*: 45-51.
- Bledsoe, G. H., Li, G. and Levy, F. (2005), Injury risk in professional boxing, *Southern Medical Journal*, 98, 10: 994-998.
- Castile, L., Collins, C. L., McIlvain, N. M. and Comstock, R. D. (2011), The epidemiology of new versus recurrent sports concussions among high school athletes, 2005–2010, *British Journal of Sports Medicine*, doi: 10.1136/bjsports-2011-090115.
- Engebretsen, L., Soligard, T., Steffen, K., Alonso, J. M., Aubry, M., Budgett, R., Dvorak, J., Jegathesan, M., Meeuwisse, W. H., Mountjoy, M., Palmer-Green, D., Vanhegan, I. and Renström, P. A. (2013), Sports injuries and illnesses during the London Summer Olympic Games 2012, *British Journal of Sports Medicine*, Published Online First: [doi:10.1136/bjsports-2013-092380].
- Halstead, M. E., Walter, K. D. and American Academy of Pediatrics, Council on Sports Medicine and Fitness (2010), Sport-related concussion in children and adolescents, *Pediatrics*, 2010; 126, 3: 597-615.
- Junge, A., Engebretsen, L., Mountjoy, M. L., Alonso, J. M., Renström, A. F. H., Aubry, M. J. and Dvorak, J. (2009), Sports injuries during the summer Olympic Games 2008, *The American Journal of Sports Medicine*, 37, 11: 2165-2172.
- Koh, J. O. and Cassidy, J. D. (2004), Incidence study of head blows and concussions in competition taekwondo, *Clinical Journal of Sport Medicine*, 14, 2: 72-79.
- Koh, J. O. and Watkinson, E. J. (2002), Video analysis of blows to the head and face at the 1999 World Taekwondo Championships, *Journal of Sports Medicine and Physical Fitness*, 42, 3: 348-353.

Loosemore, M., Knowles, C. H. and Whyte, G. P. (2008), Amateur boxing and risk of chronic traumatic brain injury: systematic review of observational studies, *British Medical Journal*, 4 October 2007, doi:10.1136/bmj.39342.690220.55 (abridged text, in print: *BMJ* 2007; 335: 809-12).

O'Sullivan, D., Fife, G., Pieter, W. and Shin, I. (2013), Safety performance evaluation of taekwondo headgear, *BJSM Online First*, published on January 24, 2013 as 10.1136/bjsports-2012-091416.

Pieter, W. (2009), Taekwondo, In: D. Caine, P. Harmer and M. Schiff (eds.), *Epidemiology of Injury in Olympic Sports*. International Olympic Committee Encyclopaedia of Sports Medicine, Oxford: Blackwell Publishing, pp. 249-259.

Pieter, W., Fife, G., O'Sullivan, D. (2012), Competition injuries in taekwondo: a literature review and suggestions for prevention and surveillance, *British Journal of Sports Medicine* (invited), 46, 7: 485-491, doi:10.1136/bjsports-2012-091011.

Pieter, W. and Kazemi, M. (2007), Competition injuries in young Canadian taekwondo athletes, In: Song, J. K. and Yoo, S. H. (eds.), *1st International Symposium for Taekwondo Studies*, Beijing: Capital Institute of Physical Education, pp. 197-206.

Pieter, W., Van Ryssegem, G., Lufting, R. and Heijmans, J. (1995), Injury situation and injury mechanism at the 1993 European Taekwondo Cup, *Journal of Human Movement Studies*, 28, 1: 1-24.

Post, A., Oeur, A., Hoshizaki, B. and Gilchrist, M. D. (2013), An examination of American football helmets using brain deformation metrics associated with concussion, *Materials and Design*, 45, 659-662.

Potter, M. R., Snyder, A. J. and Smith, G. A. (2011), Boxing injuries presenting to U.S. emergency departments, 1990-2008, *American Journal of Preventive Medicine*, 40, 4: 462-467.

Powell, J. and Barber-Foss, K. D. (1999), Traumatic brain injury in high school athletes, *JAMA*, 282, 10: 958-963.

Schulz, M. R., Marshall, S. W., Mueller, F. O., Yang, J., Nancy L. Weaver, N. L., Kalsbeek, W. D. and Bowling, J. M. (2004), Incidence and risk factors for concussion in high school athletes, North Carolina, 1996-1999, *American Journal of Epidemiology*, 160, 10: 937-944.

Tommasone, B. A. and Valovich-McLeod, T. C. (2006), Contact sport concussion incidence, *Journal of Athletic Training*, 41, 4: 470-472.

Zazryn, T., Cameron, P. and McCrory, P. (2006), A prospective cohort study of injury in amateur and professional boxing, *British Journal of Sports Medicine*, 40, 8: 670-674.

Zemper, E. D. (2003), A Two-year prospective study of relative risk of a second cerebral concussion, *American Journal of Physical Medicine & Rehabilitation* 82, 9: 653-659.

Wellness Fit Programme at University Sport Centre department

Alena Pokorná, Renata Východilová, Hana Vrtělová

Faculty of Sport Studies, Masaryk University, Brno, Czech Republic

Abstract

The aim of this paper is to introduce a new sports course/subject called Wellness Fit Programme, which was launched by the University Sports Centre department in the spring term 2013 within both the optional/paid and compulsory Physical Education study programmes. The main goal of this new programme was to strengthen students' attitude towards active and healthy lifestyle and to broaden the offer of the department. We wanted to find out the most important motivation factors of the students' choice of this newly introduced sports course in the form of inquiry subsequently. The survey was supposed to obtain the feedback from students after completing the Wellness Fit Programme.

Keywords: *Wellness Fit Programme, movement activities, exercise programme, healthy lifestyle.*

Introduction

Among the words expressing the state of our mind can be doubtlessly included words as happiness, fitness and wellness. Wellness is considered a new way of health care and means more than fitness, which is rather domesticated and very well-known term in our country. It is not about physical proficiency or fitness only, but it is our lifestyle where fitness plays a very important role as the basics of healthy lifestyle and well-being. If we feel fit and happy, we are simply at ease (Cathala, 2007).

Wellness as a kind of lifestyle requires the changes in our behaviour and attitudes, which improve our health and the quality of life, extend our life span and bring contentment. Wellness is about the way, procedures and attitudes we adopt for treating ourselves and the others. It is a complex term that includes the quality of our nutrition, even temper, the approach towards nature, personal habits, the care we dedicate to our body and personal improvement. If we try to compensate everyday stress and find the harmony of our body and mind, we improve our health as well as we enhance the quality of life and the enjoyment of life (Blahušová, 2005).

Wellness is becoming and will be one of the most frequent words in the new movement for health. This movement involves a great deal of various methods, techniques, treatments and procedures in fitness centres, gyms, clubs, hotels and spa facilities.

The signs of wellness could be found in the ancient Greece where they were known as the principle of *kalokagathia*, which involved the mental and physical equilibrium. Body and mind care blossomed in the ancient Rome and was known in the ancient Egypt too, where different beauty cosmetics were commonly used.

Wellness as it is known today appeared after the WW2 and it was Mr. Halbert L. Dunn, an American doctor, who promoted it widely. He introduced the word “wellness”, which was created as a combination of the words “well-being” and “fitness” or “happiness”. He described it as a disciplined dedication for the pursuit of personal perfection and as a lifestyle focused on the achievement of physical and mental peace or shortly as well-being. This theory led to the creation of the National Wellness Institute in 1977, whose principal aim is to support the development of healthy lifestyle and to offer the information and services endorsing the development of healthy lifestyle for the public and the information and services supporting the personal and professional development of people working in the field of wellness. The French use the term “*bien être*”, the Italians say “*bene sere*” and both these terms mean to be well and at ease (Cathala, 2007).

The movement became commonly known in the 1980’s and it spread both around America and Europe. In 2007 wellness flowered in the Czech Republic a lot. Different workshops, seminars, conferences, spa programmes and wellness treatments have been placed on the list of services offered in health centres and similar institutions since then. The introduction of the Czech Wellness Association has been the peak of this development.

Methods

The questionnaire survey (inquiry) was used to obtain substantial and detailed information from the students, which was used to interpret and evaluate the Wellness Fit Programme. The questionnaire included questions about the anonymous basic data of the student study profile, 7 closed and 1 open question.

Another method used and involved in the programme was the arrangement of the course exercise programme itself, which the students completed under our professional administration.

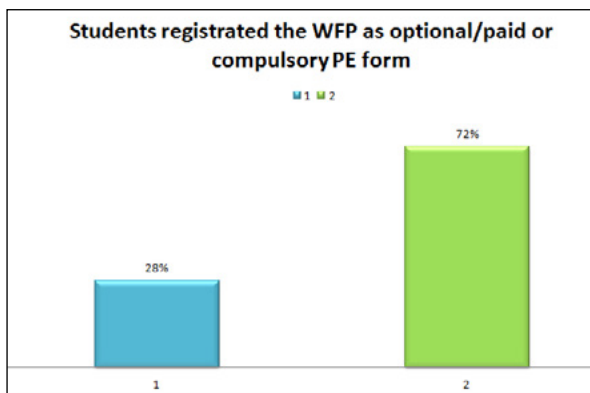
The timetable of the exercise programme of the weekend course included 17 exercise lessons and 3 lessons of relaxation – jacuzzi and sauna:

The exercise programme included: Friday: 1 Pilates lesson, 3 Nordic walking lessons + keep-fit exercise (outdoor fitness), 1 lesson of aqua aerobics and keep-fit swimming, 1 table tennis lesson, 2 lessons of sauna and jacuzzi. Saturday: 1 body balance lessons/fitness yoga, 3 Nordic walking lessons + cognitive trip to Luhačovice, 1 lesson of aqua

aerobics, 1 Movidia lesson, 1 lesson of fitness yoga, 2 lessons of sauna and jacuzzi Sunday: 1 Pilates or fitness yoga lesson, 1 lesson of body forming, 1 lesson of functional training, 1 keep-fit swimming lesson.

Results and discussion

The data we obtained in the questionnaire that the participants answered after completing the Wellness FIT course were interpreted on the basis of frequency incidence (%). 53 students of Masaryk University participated in the programme (6 men and 47 women). At the Pict. 1 you can see that 10 students registered to the programme within the optional//paid form of PE and the other participants completed the programme within the compulsory PE form. It must be mentioned that the students who registered within the compulsory form were given preference.



Legend: 1 (n) – compulsory PE form, 2 (n) – optional/paid PE form, WFP – Wellness Fit Programme, PE – physical education

Fig. 1 Students MU registered The Wellness Fit programme

Evaluation of the questionnaire:

1. Why did I choose the course?
2. Do you agree with the compulsory PE form as an obligatory part of the study programme at Masaryk University?

We wanted to find out the students' attitude towards the compulsory form of PE as an obligatory part of the study programme at Masaryk University. Thus one of the questions focused on this field. 91 % of the questioned students agreed with this form

of PE. Only 28 % of students stated that they had chosen the Wellness fit programme to complete the compulsory form of PE. Surprisingly, 72 % of respondents wanted to experience an active weekend and 59 % of respondents highly appreciated the programme (at the fig. 2). The findings show that the aim of the programme was fulfilled and students are keen on spending their free time actively. It can be also stated that the aim of the lecturers and teachers at the Faculty of Sports Studies at Masaryk University should constantly be to provide and create active exercise programmes and courses as an obligatory part of study programmes at MU for students and to support them to be concerned with active lifestyle and health care, to live actively and healthily, simply “to live wellness”.

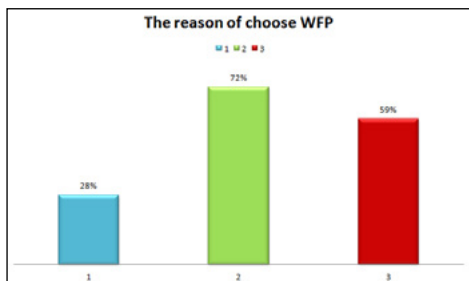


Fig. 2 Why did I choose the course? (question 1)

3. Do you think that the chosen environment and the price of the Wellness Fit Programme are convenient for students?

4. Which part of the programme did you like most and why?

5. Would you recommend the participation in this PE programme to other students?

The chosen environment, namely the spa resort of Luhačovice, was evaluated as very good. All students (100 %) answered affirmatively that they really liked it as well as they were satisfied with the price.

The place and the price overtook their expectations. They also appreciated the possibility to choose from a wide range of exercise activities, which most of them had never tried before, especially Nordic walking and inline skating, aqua aerobics, Movida fitness and Core training plus sauna. The students also appreciated the offer of outdoor activities and the hiking trip around the local dam and the visit of the spa of Luhačovice with its healing springs. The majority of the students considered the possibility to spend an active weekend and the lectures approach highly satisfying.

6. Do you do physical activities regularly in your free time?

7. What physical activities do you prefer?

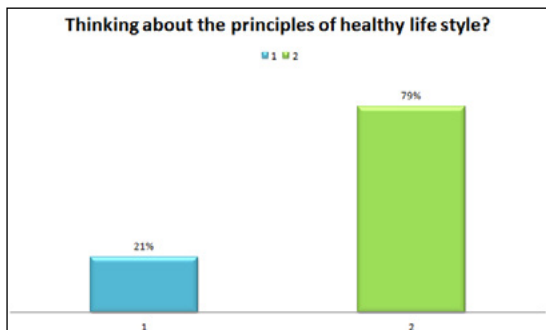
The basic characteristics of physical activities (PA) are: the capacity, structure (type of PA), exercise intensity and frequency. The main determinants of the basic characteristics are the age, gender, health and functional state as well as the goal of physical activity. The structure of physical activities is represented by endurance, muscle power, skilfulness, mobility, coordination (Fialová, 2003).

It can be stated that the results of the findings showing the students' interest in physical activities as a part of their free time schedule are satisfying. Almost 91 % of respondents do sport regularly and physical activity is an inseparable part of their life. 74 % of them prefer aerobic activities (bicycle, jogging, inline skating, swimming etc.). 26 % of the respondents prefer slow and fluent sports forms known as "Body and Mind" (Pilates, Fitness Yoga, Remedial Exercise) and 4 % of students prefer ball games contingent on a group of people.

8. Do you think that you follow the principles of healthy lifestyle?

The formation of the attitude towards exercising and sport as a vital part of life and active lifestyle is a lifelong and complex process that starts in the early childhood and continues within PE classes at elementary and secondary schools. The family attitude is also a very important aspect which participates in this process.

On the basis of the survey done in the form of questionnaire it was found out that 21 % of students do not think about (Pict. 3), are not concerned with and do not follow the principles of healthy lifestyle. For this reason a theoretical lectures introducing the main principles of active and healthy lifestyle as well as the factors influencing it should be provided to students in the future.



Legend: 1 – No, 2 -Yes

Fig. 3 Do you think that you follow the principles of healthy lifestyle? (question 8)

Conclusion

The Wellness Fit Course provides an active 3-day exercise programme which partakes in the support of healthy lifestyle and in the enhancement of preventive, health and educational significance of movement activities in students at Masaryk University. The Wellness Fit Course includes exercise programmes that harmonize both physical and mental parts of a human.

On the basis of the students' feedback we can present that thanks to the complex exercise programme of the course, a deep emotional movement sensation was evoked in the participating students. They as well appreciated the opportunity to try movement activities unknown and new for them before. Their motivation and attitude towards regular movement activities as well as the active free time utilization have also been strengthened. We, the lecturers, can state that social contacts and relations have been positively strengthened in the form of newly formed amities too.

The students also highly appreciated a cognitive tour around the spa of Luhačovice that situated in the picturesque landscape of Bílé Karpaty. It supported their cultural and educational development. It offered them the possibility to taste the local springs of Vincentka, Amandka, Ottovka and doctor Šťastný.

References

Blahušová, E. Wellness konsultant. Manual. Praha: Wellness Evy Blahušové, 2005.

Cathala, H. Wellness od vnějšího pohybu k vnitřnímu klidu. Praha: Grada, 2007.

Fialová, L. Body image jako součást sebepojetí člověka. Praha: Karolinum, 2001.

Fialová, L. Psychika a sport u české dospělé populace. Praha: FTVS, celofakultní seminář společenskovední sekce, 2002.

Life style and environment influences on body fat in adolescent's population

Ivan Uher, Milena Švedová, Rastislav Feč, Alena Buková

Department of Physical Education and Sport, Pavol Jozef Šafárik University in Košice, Košice, Slovak Republic

Abstract

Strong state of science supporting the health benefits of regular physical activity among young population. Therefore, understand the factors that influence physical activity in adolescent's population can aid the design of more effective interventions that will help young people to become more activity. Previous studies, investigating correlates of youth physical activity, life style, demographic characteristics and body fat have produced conflicting results. All study participants completed a standard questioner on selected correlates of parent's involvement in physical activity and selected demographic characteristic. Percentage of body fat accumulation in freshmen students was investigated by the means of (Emron BF 511). Results were summarized with comprehensive analyzes for female n=1139 young adults 18-20 years of age from University of P.J. Šafarik in Košice 2012. Our cross sectional study was a part of VEGA project "Selected risk factors of obesity and its prevention by physical activity" č.1/1343/12. Variables that were consistently associated with higher percentage of body fat in students was lack of parent's adoption to healthy life style recommendations, participation and guidance of their kids towards physical activity. Contrarily, we did not found statistical significance between selected demographic characteristics and higher percentage of body fat in selected sample. In order to improve the success of health in young population, we recommend health promotion activity campaign with relevant tailored messages that should be used to target parents' population. These consistently related variables should be confirmed in prospective studies, and intervention to improve the modifiable variable should be developed and evaluated in order to improve overall healthy behavior of young population.

Keywords: *University students, Urban and Rural population, overweight, Cohort study, Healthy life style.*

Introduction

The prevalence of obesity has increased dramatically in recent decades among young Slovak population (Dobří, 2008), As a result, we have several reasons for focusing

our effort to prevent excessive weight gain in cohorts in relatively young age. First, overweight at a relatively young age predicts excessive weight gain in the future (Margarey et. al., 2003; Saelens et al., 2002) Further, adolescents have a relatively short history of unhealthy habits, which may make it easier to change these behaviors compared to adult population. The role of the parents in the development of youth weight status is increasingly emphasized in intervention studies on the treatment and prevention of adolescent obesity (Kitzmann et. al., 2010; Golan et. al., 2006). Parents are the primary caregivers, who are largely responsible for their kids nutrition and physical activity patterns therefore lifestyle, particularly in the early years of life. Further overweight youth are at increased risk of becoming obese adults, these adolescents often suffer from social consequences like teasing and discrimination (Washington, 2011) which may influence their mental health. It is therefore important do develop and evaluate interventions to reverse this trend of increasing prevalence. In recent decades, youth obesity interventions have been developed and evaluated, with some promising results (Kitzmann et. al., 2010), but there is still a lack of sound theory and evidence base interventions to prevent overweight in young population.

The household is recognized as a setting for intervention because it is an environment where children can develop obesogenic behaviors (West, 2007). Parents can set household practices that influence children's weight, including limiting sedentary activities and emphasizing an active lifestyle. Parental practices can also influence levels of physical activity among children because active parents tend to have children who are more active (Doak et. al., 2006; Margarey et. al., 2003; Epstein et. al., 1994). Previous studies have not extensively compared household practices with adolescents weight related behavior. The main objective of this study was to assess whether adolescents who live in household that follow healthful practices more specifically, parents follow healthy life style, exercise regularly and guide their kids towards participation in physical activity are less overweight. A second aim of this study was to examine whether place, population of permanent residence and number of siblings were associated with lower accumulation of body fat in young adults population.

Methods

This study was part of VEGA project undertaken by University P. J. Šafarika in Košice between years 2012-2014. Our focus group, convenience sample, involved n=1139 female adolescent's (age 18-20 years, freshmen students). A brief, research designed questionnaire was used to gather household and some demographic data, that was consequently compare to accumulation of percentage of body fat by the means of BIA Bioimpedance analysis (McCarthy, 2006).

(Omron BF11, accuracy +/-3,5%.) Household practices was assessed with 3 questions using a 4 point response format (strongly agree, agree, disagree, strongly disagree) to the first and (yes/no) to the remaining two questions.

We ask freshmen students to what extend they agreed with the following statements.

•Do your parents follow general health recommendations? (Question 9) where we took into account exercise for health, habit forming substances and eating habits.

•Are your parents participating regularly in physical activity? (Question 10)

•Did your parents' guide you towards physical activity? (Question 11)

Demographic characteristics were assessed with 4 questions.

•Place of residence (urban or rural). (Question 1)

•Number of siblings in the family. (Question 2)

•Population of the residence where you live (0-1000, 1001-5000, 5001-10 000, 10 001-50 000, 50 001-100 000, over 100 000). (Question 3)

•Where you live write now (home, boardinghouse, private). (Question 4)

For statistical analysis we used non-parametric Kruskal-Wallis one way analysis of variance and Mann-Whitney U test. Significance was set at $p < 0,05$.

Results

Tab. 1 Answers to selected lifestyle and demographic questions in percentage values

Questions	1	2	3	4	9	10	11
0		Siblings 11.91					
1	Urban 57.52	48.65	Population 23.91	Home 47.30	Strongly agree 4.81	Yes 31.08	Yes 60.98
2	Rural 42.48	27.03	20.44	Dorm 43.16	Agree 35.39	No 68.50	No 38.60
3		8.36	9.54	Privat 8.87	Disagree 53.63		
4		2.20	16.47		Strongly Disagree 6.00		
5		0.84	5.74				
6		0.42	23.40				
7		0.42					
8		0.17					

Tab. 2 Selected lifestyle and demographic questions compare to percentage of body fat in freshmen students

Independent variables	Probabilities
1.Place of residence	0.1263
2.Number of siblings in your family	0.7744
3. What is the population of your permanent residence	0.9106
4. Where you live at the present time	0.3047
9. Do your parents follow general health recommendations?	0.0018
10. Do your parents participate regularly in physical activity	0.0169
11. Did your parents guide you towards physical activity	0.0019

Abbreviation: *Kruskal-Wallis ANOVA test-H, p<0,05.*

As a result of statistically significant differences between selected lifestyle questions and % of body fat and no-statistical significant in demographic variables and body fat, presented in Tab.2. We look further into have the students answered questions related to healthy behavior and body fat (questions 9,10,11). Illustrated in Tab. 3.

Tab. 3 Value differences in selected lifestyle variables in comparison with percentage of body fat in freshmen students

Independent	Dependent	Valid N	Mean	Std. Dev.	Median	Quartile range
	% Fat	1139	29.3078	16.826	28.7	10.4
9.1	% Fat	53	29.85849	22.15804	27.9	11.3
9.2	% Fat	407	30.0730	16.389	29.6	10.2
9.3	% Fat	610	29.2077	16.761	28.1	9.7
9.4	% Fat	69	25.2565	14.927	25.6	11.2
10.1	% Fat	786	29.6981	16.953	29.1	10.2
10.2	% Fat	353	28.4388	16.532	27.4	10.3
11.1	% Fat	443	30.7165	18.435	29.6	9.5
11.2	% Fat	696	28.4112	15.666	27.8	10.5

Abbreviation: *Descriptive statistical analysis*

9. Do your parents follow general health recommendations? (4. strongly agree, 3. agree, 2. disagree, 1. strongly disagree)

10. Do your parents exercise regularly? (1yes/2no)

11. Did your parents guide you towards physical activity? (1yes/2no)

Association in questions 9,10,11 and body fat (H-test), eventuate as to employ post hoc analysis to find if there is statistical significance in subgroups of selected questions, presented in tab. 4.

Tab. 4 Intra-individual differences among selected lifestyle variables and percentage of body fat in freshmen students

Idependent	Dependent	Rank Sum	Rank Sum	Mann-Whitney U-test	Z Value	p-value	Z Value	p-value	Valid N	Valid N
9. (1 - 2)	% Fat	11292.00	94738.00	9861.00	-1.01503	0.310094	-1.01505	0.310084	53	407
9. (1 - 3)	% Fat	17238.50	202877.5	15807.50	-0.266914	0.789535	-0.266919	0.789532	53	610
9. (1 - 4)	% Fat	3557.500	3945.500	1530.500	1.536606	0.124391	1.536720	0.124363	53	69
9. (2 - 3)	% Fat	216710.0	300943.0	114588.0	2.080170	0.037511	2.080206	0.037507	407	610
9. (2 - 4)	% Fat	100931.5	12594.50	10179.50	3.65482	0.000257	3.65489	0.000257	407	69
9. (3 - 4)	% Fat	211690.5	19169.50	16754.50	2.77782	0.005473	2.77787	0.005472	610	69
10.	% Fat	459942.5	189287.5	126806.5	2.322142	0.020226	2.322179	0.020224	786	353
11.	% Fat	269302.0	379928.0	137372.0	3.10257	0.001919	3.10262	0.001918	443	696

Abbreviation: Menn-Whitney U test, P<0,05

9. Do your parents follow general health recommendations? (4. strongly agree, 3. agree, 2. disagree, 1. strongly disagree)

10. Do your parents exercise regularly? (1yes/2no)

11. Did your parents guide you towards physical activity? (1yes/2no)

Discussion

To our knowledge no other study in our country have simultaneously examined whether certain demographic characteristics and parents healthy recommendations associated with accumulation of body fat in freshmen adolescents population. We observed, that young adults whose parents follow general health recommendations (avoiding habit forming substances, eating proper diet, participate regularly in physically activity and guide their kids towards physical activity) have less body fat. Contrary to our expectations no association was found when we took into account certain demographic characteristics. Follow healthy recommendations, been physically active and guide own kids toward physical activity was the only household practice significantly associated with body fat measurement. Therefore, healthy lifestyle may be surrogate measure for healthy family behavior, that includes participation in physical activity and potentially other behavior such as more healthful eating and all others healthy lifestyle measures. However when we look more closely into answers to selected questions we found that 54 % of students stated that their parents did not

follow the general healthy recommendations, 69 % do not participate regularly in physical activity, but on the other hand 61 % of parents' guide their kids toward participation in physical activity. In spite of parents recognition of healthy behavior the role model is missing, that from our perspective can further enhance healthy life style of their of springs, that aspect need further investigation.

Our study has limitations. The cross sectional nature of the data limits our ability to examine causality. Although we acknowledge the potential limitation of self-report, the health behavior measures were associated with the household variables as expected and, as such, support the potential validity of these measures. Further, the applicability of this study to all freshmen students is limited because of convenience sampling, this study helped us gain inside into how young adults enrolled in university are to some extend influenced by their parents lifestyle. Furthermore, we will follow freshmen students for the next three years to find to what extend school environment can influence body composition in selected sample of university students.

Conclusions

Selected demographic characteristic did not associated with overweight but need further investigation. However parents' lifestyle is a relevant to sedentary behavior of their kids (Sanne et. al, 2012; Park et. al, 2007). This study did not account for all other factors that contribute to non-participation in physical activity. Because the parent's variables were developed for this study, the validity of these measures warrants further investigation. The potential effect of the school and community environment was not examined but is acknowledged as a limitation, given its potential influence on behaviors (Boyd et. al., 2007; Whitlock et. al., 2010). Our findings provide evidence that the household environment is associated with certain behavior and suggests that being active as a family, more specifically guidance towards healthy life style rather than being personal example might be relevant factor for adolescent overweight and obesity prevention.

Our recommendations calling attention to the importance to studying also the social and environmental context, personal example of parents, surroundings in which adolescents develop and function, and their influence on various aspects of adolescent health. Alongside family characteristics also peers, school, communities, health care services and economic status.

We should test current theories, using validated theories to inform adolescent research and intervention projects, and generating new theoretical models to better understand adolescent healthy and development. This finding underscores the need to better understand the profiles of healthy families, personal adoption of healthy measures of the parents a subject that has not been examined in depth.

As recommended by the literature, talking to targeted end users of healthy living interventions is important because recommending costly diets and structured exercise programs without first exploring populations in our case parents lifestyle preferences is counterproductive (Kotler et. al.,1989; Andraesen et. al.,1995; Minkler et. al., 2003). Lastly, we must take more seriously the obligation to inform the public about important findings in adolescent health, using language that is accessible to a broad audience that includes parents, providers and young adults themselves.

References

Andreasen A. R.: 1995. Marketing social change. Changing behavior to promote health, social development, and the environment. San Francisco (CA). Jossey-Bass.

Balogopal P., George, D., Pantton N., et. al.: 2005. Lifestyle-only intervention attenuates the inflammatory state associated with obesity: A randomized controlled study in adolescents. *Journal of Pediatrics* 146(3):342-348.

Boyd, J. K., Braun, K. L.: 2007. Supports for and Barriers to Healthy Living for Native Hawaiian Young Adults Enrolled in Community Colleges. In: Preventing chronic disease. Public health research, practice and policy. Volume 4. No.4.

Doak, C. M., Visscher, T. L., Renders, C. M., Seidell, J. C.: 2006. The prevention of overweight and obesity in children and adolescents: a review of interventions and programmes. *Obes Rev.* 111-136.

Dobry, L.: 2008. Poznatky o zdravotnich benefitech pohybove aktivity mladeze – vychodisko ke zmene pojeti telesne vychovy a sportu mladeze. *TVSM*, roč. 74, č. 1, 2008. s. 12-18.

Epstein, L. H., Valoski, A., Wing, R. R., McCurley, J.: 1994. Ten-year outcomes of behavioral family-based treatment for childhood obesity. *Health Psychol.* 13(5): 373-383.

Golan, M., Kaufman, V., Shahar, D. R.: 2006. Childhood obesity treatment: Targeting parents exclusively v. parents and children. *Br J Nutr.* 95(5): 1008-1015.

Ketler, P., Roberto, E. L.: 1989. Social marketing strategies for changing public behaviour. New York (NY): Free Press.

Kitzmann, K. M., Dalton, W. T., Stanley, C. M., Beech, B. M., Reeves, T. P., Buscemi, J., Egli, C. J., Gamble, H. L., Midgett, E. L.: 2010. Lifestyle interventions for youth who are overweight: a meta-analytic review. *Health Psychol.* 91-101.

Margarey, A. M., Daniels, L. A., Boulton, T. J., Cockinton, R. A.: 2003. Predicting obesity in early adulthood from childhood and parental obesity. *Int J Obes.* 505-513.

McCarthy, H. D.: 2006. Interpretation the body fat percentage. *International Journal of Obesity*, Vol. 30.

Minkler, M., Wallerstein, N.: 2003. Community based participatory research for health. San Francisco (CA).

Park, T. G., Hong, H. R., Lee, J., Kang, H. S.: 2007. Lifestyle plus exercise intervention improves meta- bolic syndrome markers without change in adiponectin in obese girls. *Ann Nutr Metab.* 51(3):197-203.

Sanne, G., Dagnelie, P. C., Jansen, M., Van der Goot, L., Vries, N., Sanders, M. R., Kremere, S.: 2012. Lifestyle Triple P. A parenting intervention for childhood obesity. *BMC. Public Health* 12:267. Doi. 10.1186/1471-2458-12-267.

Saelens, B. E., Sallis, J. F., Wilfley, D. E., Patrick, K., Cella, J. A., Buchta, R.: 2002. Behavioral weight control for overweight adolescents initiated in primary care. *Obes. Res.* 10(1):22-32.

West, F.: 2007. The Lifestyle Triple P Project. Exploring the link between parenting and childhood obesity. University of Queensland. School of Psychology.

Washington, R. L.: 2011. Childhood obesity: issues of weight bias. *Prev Chronic Dis,* 8: A94.

Weigel, C., Kokocinski, K., Lederer, P., Dötsch, J., Rascher, W., Knerr, I.: 2008. Childhood obesity: concept, feasibility, and interim results of a local group-based, long-term treatment program. *J Nutr Educ Behav.* 40(6): 369-373.

Whitlock, E. P., O'Connor, R. E. Williams, S. B., Beil, T. L., Lutz, K. W.: 2010. Effectiveness of weight management interventions in children: A targeted systematic review for the USPSTF. *Pediatrics.* 125(2). Available at: www.pediatrics.org/cgi/content/full/125/2/e396.

The working conditions and injuries of students as a source of stress of physical education teachers

Zuzana Tulisová

Faculty of Sport Studies, Masaryk University, Brno, Czech Republic

Abstract

The present study focused on examining of specificities of physical education teachers. The aim of this article is to introduce the partial results of quantitative research that focused on specificities which have been mentioned with a special respect to perception of the burden of security risks.

Special attention is also paid to relation between the concepts of teacher training (eg. performance leadership, health care of students, performance appraisal, etc.) with the perception of burden associated with injury rates of students and burdens of unfavorable conditions in the workplace.

The obtained data are compared with data from questionnaire by the original author; they are interpreted and discussed with regard to the realities in Czech schools. At the same time, the obtained data are compared with the results of those authors who have dealt with injury rates in sport and physical education, for example, Kemeny (1998), Rohnstock (2000) and others.

Keywords: *PE teacher; burden, approach of teaching, injury, security.*

Introduction

Teaching is generally classified as a profession with a high load. According to the classification which was used in the psychology of work, includes output in the profession of PE teachers in the fourth (and the highest as well) category in terms of neuropsychological tension. In terms of work load, following reasons act negatively: the particular high numbers of students in classes and thus in physical education classes, high dynamics of changing situations and heightened security exercises conducted, etc. (Ilin, 1987). Injuries and accidents cannot be avoided in physical education, of all accidents registered at schools, the physical education covers 52.3 % (Tupý, 2010).

There are many factors involved in the accident rate and it is clear that the responsibility for injury during physical education present teacher carries mostly (Metodický pokyn, 2006). This increases the subjective feeling of responsibility and thus feels the workload.

The largest number of accidents is included in the school physical education (Kemeny, 1988) and as it has been mentioned above, more than the half of the injuries are caused by physical education; the highest risky group are children aged from 13 to 16 years (Tupý, 2010). It is interesting that the most accidents at Czech schools become during some ball games (Černá, 2009). Overall, these are exercises that are well known for students and they are very simple. The rate of recovery may therefore be related to carelessness (Klein-Hessling, Jerusalem & Schlesinger, 2003, Hundeloh, 2005).

Currently, there is no manual that would clearly identify how to treat the teacher to get into conflict with the law, if in charge of a group of students who are at risk of injury. The authors therefore tend to focus on the mistakes the teachers in terms of injuries most often perpetrated. Eg. Fialová (2002) describes common mistakes made by teachers of physical education that result in injuries:

- the absence of the teacher before, during or after school classes,
- faulty methodology,
- errors in the organization of teaching,
- failure to provide safety information,
- failure to provide conditions for teaching,
- inadequate task,
- failure to observe the number of pupils,
- neglect first aid,
- failure to non-practicing activities.

For physical education teachers, it may be difficult to discern the cause of injury and safely to ensure safe education (Xiao, 2001). At the same time physical education teacher has to have basics of first aid. Lee (1995) and Fitzgerald (2009) see the problem and the fact that some parents do not inform the school about the health of their children, which also lead to a higher may risk of accidents.

Natural defenses teachers then attempt to adjust working conditions, which in many cases designed to prevent the accident.

In this paper, we connect closely related topics workload of PE teachers in our view, accident rate of pupils and perception of working conditions. The text aims to discuss the issue of accident rate pupils in relation to the load and the working conditions of teachers of physical education. We present partial results of research conducted in the dissertation¹, the aim of which is to discuss the specifics of physical education teachers. It is obvious that it will be focused only on results relating to the above sub-themes.

¹ PhD thesis is realized at the Faculty of Sports Studies of Masaryk University in Brno.

Methods and Results

The specifics of physical education teachers: stress, accident rate, conditions of work

For a description of the characteristics and specificities of teaching physical education, we chose a combination of quantitative and qualitative research. In the first phase of the research, the questionnaire was used, which was inspired by research Voltmann-Hummes (2008), who examined the burden of physical education teachers and their ability to cope with it. This research compares the burden on the teachers of different types of schools – elementary, grammar school, vocational school, etc. We focused only on secondary schools, because of the framework form of teaching content (as RVP) and differentiation of teachers at secondary schools according to the subjects taught.

Our questionnaire consisted of four parts, which were aimed at self-physical education teachers, teaching approaches, and load support. Total number of items in the questionnaire was 105. For the purposes of this post, only those items that relate to the issue of the covered risks and conditions in physical education classes in primary schools were selected from the questionnaire and processing.

The respondents were teachers of physical education of the second degree Czech primary schools. The basis for the research group was a list of primary schools in the Czech Republic available on the website of the Ministry of Education, Youth and Sports (www.msmt.cz), which was selected randomly using the Microsoft Office (<http://office.microsoft.com/cs-cz/excel-help/nahcislo-HP005209229.aspx>). It was worked with 15 schools from each region, 210 schools in total. The management of these schools was sent a link to a website with a request PE teacher to fill in a questionnaire. We therefore accurate capture of how many PE teachers in this way we actually talked to. Sampling was not limited by the experience in the profession or by the size of the school.

The total number of completed questionnaires completely settled at number 136.

Characteristics of the research group

In terms of gender, the group of 72 women and 64 men, which clearly indicates a different gender distribution among physical education teachers and teachers of other subjects than describes Jůva (Lazarová, 2011). We do not take into account potential increased willingness of men to participate in surveys, which, as we know, has not been proven yet.

The age of respondents ranged from 24 to 66 years, with an average age of 42.6 years. The highest number of respondents aged 31-40 (29%); the dominant age is 33 years (8 persons). Similarly, research Voltmann-Hummes confirms the high frequency

of teachers in the file aged 31-40 years (25.6%). From this perspective, our files are comparable. The highest number of respondents – teaches at the school less than 5 years and the average length of experience in the investigation file is 17.3 years. It is obvious that the results obtained may be influenced by the relatively high number of respondents with minimal practice. On the other hand, it can be assumed that even after 5 years of practice, respondents are able to identify risks of their work.

In terms of subject combinations, only 11 teachers who were asked, taught physical education as the only subject, 92 % of teachers teach also second or third subject. Mostly it is geography, followed mainly by science subjects such as mathematics, IT education, or biology.

The stress factors of physical education teachers

On the professional burden in the questionnaire, we asked about eighteen items. Of all the items asking the load were chosen that which are related to the rate of accidents of pupils or to unfavourable conditions in the workplace. For these items, we used a Likert scale. It means that the number 1 corresponds to the statement “not burdensome” and the number 6 represents “very burdensome“. Respondents could answer “I cannot judge it” by the number 0. Based on the evaluation of the data, we found that the burden of physical education teachers in the area of security risk is not significant and the results are closer to the average rating. (Load Index - overall average of all items focused on the evaluation of load = 2.8). Compared with other factors, however, physical education teachers of primary schools see increased risk of accidents (3.26) as one of the most burdensome factors. Physical education teachers find low motivation of students to engage in physical education classes (3.61) and noise (3.45) and administration (3.43) the most stressful. See the table 1.

Tab. 1 Burdensome factors

Burdensome factors	average value
Low motivation of students to engage in PE (unwillingness of students, pupils nonpracticing)	3.61
Noise	3.45
Administrative activities	3.43
Increased risk of accidents during the PE	3.26
Number of pupils in lessons	3.10
Lack of sports equipment	3.07
Differences in ability of pupils in the class	2.90
Preparing and tidying up of tools	2.84
Other climatic conditions of sports fields (smell, cold, drafts, light)	2.72
Working with time (after-school activities-sports events, school trips, etc.)	2.69

Increased risk of injuries in physical education classes can be considered as the important mentally challenging aspects of physical education teachers in comparison with other burdensome factors.

Regarding to categorization in terms of gender and age, the research shows that teachers-women perceive the lack of sports equipment worse than teachers-men; in other cases results were comparable for both genders.

In terms of age, teachers over sixty perceive low motivation of students to engage in physical education classes much worse than their younger colleagues. This fact can be interpreted that older teachers are often struggling to cope with declining pupils' motivation in general (Lazarová, 2011). Macdonald (1995, 1999) also confirms teachers' frustration caused by the lack of motivation and cooperation of students. In addition, Wong and Louie (2002) confirm the basis of the research, the negative attitude of pupils towards physical education is the most burdensome areas of work physical education teacher.

There were no significant differences between older teachers and younger teachers in any other item.

The perceptions of burden, subjective satisfaction/dissatisfaction of physical education teachers with their own professions were compared. It was found that teachers

expressing dissatisfaction perceive greater burden on factors such as increased risk of accidents of students in physical education classes, noise or other sanitary and climatic conditions. The question is how much perceived stress is a source of dissatisfaction.

Discussion

In comparison with the results Voltmann-Hummes (to take into account only the results of relating to primary schools – Hauptschule) it should be noted that Czech teachers seem to perceive the risk of pupils as significantly burdening factor in contrast to German research. According to research Voltamnn–Hummes, German teachers see as significantly stressful factors such as noise, poor acoustics, the number of students, etc. This poses the question as relating to differences in equipment of workplaces, organization, training, the number of pupils in Czech and German environment.

It should be noted that the most stressful factor is the perceived lack of motivation of students for teaching in general. It seems that the load of the PE teachers has been increased recently also by unwillingness of pupils to do any sport activity or exercise in general. It also appears that the burden of relating to the obligation to pursue administrative actions, but this is a factor that teachers generally perceived as very burdensome. It also seems that an important factor in the diminution of physical education teachers is noise, which is confirmed by Czech and German research.

Conclusions

Monitoring of load in the teaching profession in recent years has become the centre of attention of number of studies in the Czech Republic and abroad (Řehulka, 2005; Paulík, 2011). Questions are about the burden of physical education teachers, who can be expected by specific load factors. Partial results of our research in the Czech environment suggest some similarity implemented with German research, which became the basis of our research. Our next research steps will aim to further understanding of the specifics of teaching physical education in general, using qualitative methods, interviews with some selected physical education teachers.

We believe that qualitative probes will help us to probe deeper insight into the profession of teaching physical education and to identify the sources of occupational stress.

References

- Černá, L. (2009). Bezpečnost a ochrana zdraví v hodinách tělesné výchovy a mimoškolních aktivitách. Přednáška FSpS Brno: 29. 10. 2009.
- Fitzgerald, B. (2009). 7 Simple Rules for PE Safety. Times Union. Albany: 5.9.2009.
- Hundeloh, H. (2005). Sportunfall- ein Stressor im Arbeitsalltag der Sportlehrkräfte. Sportunterricht, 54(5), 14-145.
- Ilin, E. P. (1987). Psychologija fizičeskogo vospitanija. Moskva: Prosvjeschenije.
- Kemeny, P. (1988). Die Entwicklung der Unfallhäufigkeiten im Schulsport. Sportpädagogik, 12(5), 6-9.
- Klein-Hessling, J., Jerusalem, M. & Schlesinger, I. (2003). Gesundheitsgefahren in der Schule. Psychomed, 15(4), 230-236.
- Lazarová, B. et al. (2011). Pozdní sběr. O práci zkušených učitelů. Brno: Paido.
- Lee, S. (1995). Rules on PE safety backed. South China Morning Post. Honkong: 25. 11. 1995.
- Macdonald, D. (1995). The role of proletarianization in physical education teacher attrition. Research Quarterly for Exercise and Sport, 66, 129-141.
- Macdonald, D. (1999). The „professional“ work of experienced physical education teachers. Research Quarterly for Exercise and Sport, 70(1), 41-54.
- Metodický pokyn k zajištění bezpečnosti a ochrany zdraví dětí, žáků a studentů ve školách a školských zařízeních zřizovaných Ministerstvem školství, mládeže a tělovýchovy. (2006, 14-15). Učitel'ské noviny 2-10.
- Rohnstock, D. (2000). Belastungsschwerpunkte im Sportlehreralltag und Anregungen für gezielte Enlastungen. Sportunterricht, 49(4), 108-115.
- Rychtecký, A., Fialová, L. (2002). Didaktika školní tělesné výchovy. Praha: Karolinum – nakladatelství Univerzity Karlovy.

Tupý, J. (2010). Organizační opatření pro prevenci úrazů na školách aneb jsou informace o úrazech ve školách dostatečným podkladem pro jejich prevenci? Retrieved 12. 1. 2013 from: http://www.szu.cz/uploads/documents/czpz/zivotni_styl/kampane/seminar_8sept10/Urazy_ve_skole_a_prevence.pdf.

Voltmann-Hummes, I. (2008). Traumjob Sportlehrer/in? Belastungserleben und Selbstwirksamkeitserwartung von Schulsportlehrkräften. Göttingen: Cuvillier Verlag Göttingen.

Wong, A., & Louie, L. (2002). What professional educators can learn from practicing physical education teachers? *Physical Educator* 59 (2), 90-104.

Xiao, G. L. (2001). Analysis of responsibility confines for injury accidents in physical education teaching. *Journal of Beijing Sport University*, 24(1), 93-94.

AGEING AND PHYSICAL ACTIVITY

The effect of exercise intervention on selected functional abilities of seniors

Jitka Kopřivová, Zuzana Žecová

Faculty of Sport Studies, Masaryk University, Brno, Czech Republic

Abstract

The population of seniors living in home for the elderly people is due to this social device putting at risk a decline in their functional potential, caused by the lack of opportunities to regularly maintain their physical and mental condition. Regular inclusion of appropriate physical activities into the daily routine of an aging population in these devices appears to be an effective preventive measure or worsening health problems associated with this period of life. Maintaining functional status in this group of seniors is critical to their self-service, self-sufficiency and independence in carrying out daily activities of everyday life. Our aim is to assess the effect of regular exercise program intervention on the level of aerobic endurance and muscles force in selected group of seniors. The research was carried out in home for elderly in Brno (CZ), where for six months took place two times a weak physical intervention led by an experiences physiotherapist. Research was attended by a total of 24 women with a mean age of 83 years. Aerobic endurance was evaluated by six minute walk test (6MWT), hand grip strength was evaluated by hand-held dynamometer. To determine the significance of differences between input and output measurements, we used paired t-test with a fixed 5 % level of significance. Changes in the monitored parameters were statistically significant. The group surveyed seniors improved by the effect of a 6 month exercise intervention on their performance 19.5 at 6 minute walk. The right hand grip strength (+2.3 kg) and left hand (+1-6 kg) was increased. The influence of regular 6 months exercise intervention performed with suitably selected content exercise can positively affect the functional fitness parameters such as aerobic endurance and hand grip strength for elderly living in homes for seniors. Aerobic endurance is closely related to the mobility of seniors.

Keywords: *exercise intervention program, functional abilities, seniors, aerobic endurance, handgrip strength.*

Introduction

The population of pensioners living in homes for the elderly is due to this social device putting at risk a decline in their functional potential. This state is affected by the limited possibilities for development of both physical and mental abilities. This

device is in some way the elderly are cared for and so are forced to take care of routine activities of daily life. All this involves a gradual tendency disability. Period of age is characterized by involution changes in the body at all levels and this inactivity, which is characteristic of this population living in homes for the elderly is one of the causes of a decline in their level of physical fitness and mental state. Therefore regular inclusion of appropriate physical activities into the daily routine of an aging population in these devices appears to be an effective preventive measure onset or worsening health problems associated with this period of life. Maintaining functional status in this group of seniors is critical to their self-service, self-sufficiency and independence in carrying out daily activities of everyday life.

Functional ability in old age is indicated by Kolář (2009, p.601) as a key element of health. It is influenced by many factors such as genetic predisposition, disease patterns and their consequences, the current way of life, environmental factors and psychological state.

One of the major functional abilities components is aerobic endurance. According Kalvach (2004) aerobic endurance is determined by a combination of heredity and state systems, cardio respiratory, metabolic, musculoskeletal and psychological. Aerobic endurance is directly related to functional mobility of seniors. A marked decrease in endurance capacity occurs after 65th year. Rikli and Jones (2001, p.15) reported that after 70 year of life loss aerobic capacity of the organism by 50 %. This ability by training reduces the risk of cardiovascular disease, of Diabetes mellitus Type II, of obesity and hypertension. It belongs here activities which engage large muscle groups, alternating with its muscle tension release, movement is coordinated with breathing and energy is extracted in the presence of oxygen. The most suitable physical activity for developing aerobic endurance in old age are considered to be a dynamic cyclical nature of endurance activities such as walking or Nordic walking, cycling, or on the ergo meter and swimming. The selection must be subordinated to the state of health, age, gender, mobility experience, fitness level and interests of seniors (Kolář, 2009, p. 602). Besides aerobic endurance as a very important component of physical fitness in old age is muscle strength. The development of power capabilities culminates in the first half decade of the third, after there is a gradual deterioration. In approximately 60 years, a person retains about 80 % of its full power potential. Due involution occurs with aging muscle wasting (atrophy) and the related decline in muscle strength as well. More affected muscles on the legs with a predominance of developmentally younger and fast fibers. One of the reasons described sarcopenia is a performance penalty, hypoactivity and hypomobility. Aging are also changing hand function, involving the participation of a number of factors, including genetic, endocrine and metabolic. Age accompanies diseases such as rheumatoid arthritis, osteoarthritis, osteoporosis and other pathological changes. Hand function related to

joint mobility and strength of handgrip. With age rapidly losing, but it is possible to train. Altered hand grip strength in the aging population is a predictor of disability that leads to self-sufficient in performing common activities of daily living (ADL), as shown Giampaoli, S., Ferrucci, L., Cecchi, F., Noce, C. L., Poce, A., Dima, F. & Menotti, A. (1999, p. 283-288) and Giuliani, C. A., Gruber-Baldini, A. L., Park, N. S., Schrodt, L. A., Rokoske, F. & Sloane, P. D. Zimmerman, S. (2008, p. 203-212). Muscle strength measured static handgrip force affects the overall quality of life of elderly people.

Our aim is to assess the effect of regular exercise program intervention on selected parameters of functional abilities monitored group of seniors.

Methods

The research was carried out in a home for the elderly in Brno, where for six months took place two times a week physical intervention led by an experienced physiotherapist. Exercise unit lasted 50 min. Aerobic endurance are developed by walking around the gym or outdoors, strength abilities using unusual exercise equipment (thera-band, overball, ring, etc.), Research was attended by a total of 24 women with a mean age of 83 years. The youngest woman was 69 years old and the oldest 93 years. Condition of participation was mobility, ability to walk independently without support or with support, stick or walker free of serious disease (unstable angina, decompensate hypertension, diabetes mellitus, aneurysm states after severe myocardial infarction, terminal stages of cancer diseases). Project did not take individuals with psychiatric disorders (dementia), and who had a history of stroke. Our group of women had an average body weight of 73.6 kg and BMI 26.2. Of the 24 women we found only 12 women in the standard body weight. In 5 women, we noticed overweight, obesity in 3 women first degree, in 2 cases obesity second degree and in 2 cases even obesity third degrees. Given that this was a specific group of seniors living in senior homes, it was not possible to ensure homogeneity of the investigation file. The common characteristic for our study group was living in the home for seniors and the ability to walk independently with or without assistive devices or without them.

Aerobic endurance was evaluated by six minute walk test (6MWT), which is part of the Senior Fitness Test (Rikli & Jones, 2001, p.15). Test involves walking for six minutes and the person being tested tries miss the longest distance. During testing was permitted at any time discontinue walking and rest, standing or sitting on chairs prepared.

Hand grip strength was measured with a digital hand dynamometer. We tested the static power pressing the right and left hand. The resulting value was the average of two experiments and measured result is expressed in kilograms.

For data processing we used the methods of mathematical statistics. Applying Shapiro-Wilks test for normality of the variables, we reject the hypothesis of normality of data. Therefore, we used nonparametric tests everywhere. Based on the Wilcoxon t-test, we tested the hypothesis of equality of mean values. We chose the 5 % level of statistical significance.

Results

As evidenced by the results presented in Tab. 1, positive effect of 6-month targeted exercise intervention was reflected in an increase in the level of aerobic endurance studied group of seniors tested with test 6 MWT. The group surveyed seniors improved by the effect of a 6-month exercise intervention on their performance 19.5 m at 6 minute walk. This change was statistically significant at the 5 % level of significance.

Tab. 1 Aerobic endurance surveyed women in the input and output measurements (n=24)

variable	x/m	SD	def	SD.def	p
AE 1	265.0	68.1			
AE 2	284.5	72.8	19.5	30.8	0.005009

Legend: x/m – arithmetic mean / meter; SD – standard deviation; def. – deficiency; SD. def. – standard deviation of deficiency; p – minimum level of statistical significance; AE 1- aerobic endurance in the input measurement; AE 2 - aerobic endurance in the output measurement

From the above presented results show the importance of regular running exercises focused on aerobic endurance among elderly people living in homes for the elderly. 6 months graduation exercise intervention brought to aged women improves their level of endurance capacity.

As can be seen from Tab. 2, after our physical intervention occurred in the studied group of women also statistically significant improvement in grip strength in both hands. A much greater change in the right hand grip strength obviously points out that along with regular exercise, strength of upper limbs seem to be more women use his right hand during normal activities of daily life.

Tab. 2 Handgrip strength surveyed women in the input and output measurements (n=24)

variable	x/kg	SD	def	SD.def	p
HGR 1	13.5	3.8			
HGR 2	15.7	3.8	2.3	1.6	0.000001
HGL 1	12.1	3.5			
HGL 2	13.7	3.6	1.6	1.7	0.000139

Legend: x/kg - arithmetic mean / kg; SD - standard deviation; def. – deficiency; SD. def. – standard deviation of deficiency; p – minimum level of statistical significance; HGR 1- grip of right hand in the input measurement; HGR 2- grip of right hand in the output measurement; HGL 1 - grip of left hand in the input measurement; HGL 2- grip of left hand in the output measurement

The population of seniors living in homes for elderly has exercises designed to develop grip strength irreplaceable. Sufficiently strong handgrip is for elderly people necessary. In addition, they provide self-sufficiency in many everyday activities, such as locomotion, movement from place to place and self-service activities.

Discussion

Many authors show the positive effect of physical intervention independently on the age to develop of aerobic endurance. Reeder et al (2008, p. 74-87) observed the effect of group exercises and of home exercises during 3 months. They results show to more positive effect of group exercises then exercises providing only at home. Eyigor, S., Karapolat, H. & Durmaz, B. (2007, p. 259-271) showed Increasing of aerobic endurance by women in average age of 70,3 years using motion intervention regularly 3 times a week during 8 weeks only. Authors LdeVreede, et al. (2004) conducted their study on women living in the community for seniors. Their average age was 74.6 years. They compared the effects of two different 3 monthly physical interventions on functional ability in daily activities. They were able to positively improve the muscle strength of selected muscle groups of the upper and lower extremities, but the strength of handgrip only partially affected. It was interesting that the hand grip strength is improved only in the group where the hand muscle strength reinforced regularly. Again, we can deduce the claim that if we are interested to obtain a positive effect of exercise intervention on the endpoint, which is in our case, hand grip strength, strengthening exercises should be performed regularly. It should be emphasized that endurance skills can be developed in the group of elderly people living in a home for the elderly, which accrue very often certain functional limitations. Developing endurance

abilities greatly influences the mobility of the elderly, their overall functional status and the quality of life. Regularly performing the appropriate exercises in physical intervention programs can also reduce potential risks of falls which are in this age group have been prevalent.

Selected content exercises intervention, intensity, frequency and duration are important factors that may influence the effect increases exercise programs on functional fitness parameters monitored in the period made. At the start of exercise intervention must be respected not only age persons, but their current physical and mental condition and their level of physical fitness.

Conclusion

Although the results of our experiment is not a small number of individuals studied to generalize can at least say that the influence of regular 6 months exercise intervention performed with suitably selected content exercise can positively affect the functional fitness parameters such as hand grip strength and aerobic endurance even for seniors living in homes for seniors. Our results are evidence of the fact that even during the final phase of life can reap the benefits of regular exercise and contribute to decent and contented old age. Well-chosen exercises and their regular performance should be an integral part other services provided to seniors living in homes for seniors.

References

- Eyigor, S., Karapolat, H. & Durmaz, B. (2007). Effects of group – based exercise program on the physical performance, muscle strength and quality of life in older women. *Arch Gerontol Geriatr*, 45, 259-271.
- Giampaoli, S., Ferrucci, L., Cecchi, F., Noce, C., Lo, Poce, A., Dima, F. & Menotti, A. (1999). Hand-grip strength predicts incident disability in non- disabled older men. *Age Ageing*, 28 (3), 283-288.
- Giuliani, C. A. , Gruber-Baldini, A. L., Park, N. S., Schrodt, L. A., Rokoske, F. & Sloane, P. D. Zimmerman, S. (2008). Physical performance characteristics of assisted living residents and risk for adverse health outcomes. *The Gerontologist*, 48 (2), 203- 212.
- Kalvach, Z., Zadák, Z., Jirák, J., Zavázalová, H., & Sucharda, P. (2004). *Geriatric a gerontologie*. 1th ed., Praha, Česko: Grada Publishing.
- Kolář, P. (2009). *Rehabilitace v klinické praxi*. 1th ed. Praha, Česko: Galén, pp. 601-608.
- L de Wreede P. at al. (2004). Functional tasks exercise versus resistance exercise to improve daily function in older women: A feasibility study. *Arch Phys Med Rehabil*, 85, 12, 1952-1961.
- Reeder, B. A. at al. (2008). Saskatoon in motion: Class-versus home-based exercise intervention for older adults with chronic health conditions. *J Phys ActHealth*, 5, 74-87.
- Rikkli, R. E., & Jones, C. J. (2001). *Senior fitness test manual*. California State University, USA: Human Kinetics, 176 pp.
- Spiriduso, W. W., Francis, K. L., MacRae, P. G. (2005). *Physical dimensions of aging*. Second ed. Champaign: Human kinetics, 384 pp.

Movement and psycho-social aspects of gymnastic programs for “Golden Age“

Viléma Novotná, Iveta Šimůnková, Kristina Svobodová

Faculty of Physical Education and Sport, Charles University in Prague, Czech Republic

Abstract

In recent years, the topic of physical activity in seniors has received attention in the sport environment. It has been argued that gymnastic exercises (for women accompanied by music) represent very beneficial kind of activity that motivates older people to be physically active. In this context, the older population (age 50+) has been labeled as the “Golden Age.” The physical activity of the “Golden Age” population has been supported for example by international festivals and through educational programs at the University of the Third Age at the Faculty of Physical Education and Sport, Charles University in Prague. An international festival “Golden Age 50+” or “The International Gymnastic Festival 50+” (IFG 50+) have been organized annually by the European Union of Gymnastics (UEG). As the most important part of these festivals, public performances of group music-movement compositions have been presented allowing comparison of the repertoire and the content of music-movement compositions for seniors. At the festivals, practical and theoretical workshops have focused on a specific physical, social and aesthetic cultivation of the population of older adults. The group participation and shared experiences with the gymnastic educational programs support not only the physical fitness of the participants but also their self-sufficiency, self-confidence, and life satisfaction. At the same time, participants learn new information about the effects of physical activity which motivates them in striving for further improvements of their life conditions and overall quality of life.

The main aim of the present article is to examine basic assumptions for organization of the gymnastic programs for older adults and present arguments that show the importance of gymnastics as a motivating factor contributing to healthy lifestyle of this population. We present an overview of research that examined common properties of gymnastic programs. To evaluate selected aspects of these programs we also used the method of content analysis and examined actual programs offered at the festivals. We selected following markers of physical cultivation as the categories of the content analysis and as potential assumptions in preparing gymnastic programs: learning of consciously directed movement, mobility, balance, rhythm, physical condition, movement memory; in the context of psycho-social benefits: increasing self-awareness through movement, self-confidence, experience of skillful activity, learning

new knowledge; in the context the effects of the group preparation and the public performance of the movement composition: increasing creativity, group cooperation and coordination, group responsibility, collective aesthetic experience, experience of success, personal satisfaction.

The results of the analysis confirmed that in all festival programs most of the selected aspects have been represented. The workshops and seminars emphasized positive benefits of the exercises for various aspects of health oriented physical fitness, concentration to optimal movement performance, and shared positive experiences. The results show that the selection of physical activities for the participants of the festival was appropriate for the age group 50+.

We may conclude that the gymnastic programs, exercise with music, and movement compositions support the acquisition and cultivation of physical literacy, the quality of movement expression and bring specific shared experiences with physical activity to the participants.

Keywords: *Seniors, music-movement composition, gymnastics, physical activity, experience.*

The article was written in the framework of the scientific branch development programme UK FTVS n. 39 Social-Sciences Aspects of Human Movement Studies and it was supported by the Specific university research grant project no. 2013-297603.

Introduction

In 2005, the European Union of Gymnastics prepared a proposition of a festival with a specific program for seniors and since 2008 its committee “Gymnastics for All” has organized several “Festivals of Golden Age 50+” (in 2008, 2010, 2012, and 2014) and “International Gymnastic Festivals 50+” (IGF 50+) within the Flower Festival Gran Canaria 2009, 2011, 2013 (Telo et al., 2010). These festivals have been intended to make connections between physical activity and public life. For example, in the year 2012 (which has been declared as the European Year for Active Ageing and Solidarity between Generations) more than 1650 of participants from 19 countries joined the festival in Italian Montecatini and they performed more than 100 compositions.

The festival was mainly focused on 6-minutes music-movement compositions which introduced various national approaches towards the “gymnastics for all”. The performed compositions allowed comparing various creative approaches to the preparation and the content of movement compositions for seniors. These physical educational performances represent the contribution of the gymnastics to the international movement of “sport for

all” (Novotná & et al., 2012). In the available workshops and seminars, the gymnastic programs have focused on various goals and purposes of physical activity taking in account the age of participating seniors.

Gymnastics for all is considered as a suitable activity with harmonizing influence on the population of older adults. It supports acquisition and cultivation of specific skills of basic movement – so called physical literacy. It creates conditions for learning further basic movements and skills. It focuses on the quality of movement performance based on conscious and directed movement and on the necessary knowledge about the execution of the movement. Gymnastics programs, various kinds of exercises on music, and various forms of movement compositions allow for specific group experiences stemming from the physical activity. They are popular especially in women.

Methods

The main aim of the article is to choose the starting points for preparation of gymnastic programs for seniors and organize the main arguments showing the importance of gymnastics as a significant motivational factor supporting the healthy lifestyle. The first goal is to conduct a review of literature and research results and select common properties of gymnastic programs that harmonically influence the personalities of seniors. Following publications have been used for the review: Ettinger, Wright & Blair, 2007; Haškovcová, 2010; Holmerová, Jurašková et al., 2006; Hendl, Dobrý et al., 2011; Junger et al., 2005; Kopřivová et al., 2002; Marcus & Forsyth, 2010; Sekot, 2008; Riegrová, 2010, and other research results supported by our own experiences with organizing various physical activities for seniors. The second goal is to evaluate the gymnastic programs, workshops, and seminars of the Golden Age and IGF festivals for the population 50+ on the basis of the selected properties.

Following properties have been selected for the evaluation of the programs representatives of movement cultivation: – acquisition of consciously directed movement, – flexibility balance, – rhythm; representatives of psycho-social characteristics: – raising self-awareness through movement, – self-confidence, – experience of skilled performance, – acquisition of new knowledge. Presented movement compositions have been evaluated on the basis of live performances or video recordings and they have been examined for the inclusion of these properties into the composition. Furthermore, also other specific aspects have been added: – stimulation of creativity, – movement collaboration and group coordination, – co-responsibility, – group aesthetic experience, – sense of achievement, – satisfaction.

Following festival gymnastic programs applied to the population of seniors have been selected for the content analysis: aerobic, acrobatics, fitball, free body gymnastics, Medau

movement, exercise with hand apparatus, pilates, step, Tai chi, rhythmic exercises, folk dance, yoga. We used a broad approach to gymnastics; therefore, also the systems of Eastern exercises and dance have been included in the examined programs as they have similar principles of movement performance.

Results

Content analysis

In the examination of the workshops and movement compositions we recorded the selected properties as they appeared in the programs. The exercises took place in groups comprised of various trainees from various countries. The results of our analysis show that all selected aspects have been included in almost all festival programs. Even the programs based on typical individual exercises were organized in a way that supported mutual communication and cooperation. All programs emphasized benefits to and positive impacts on various aspects of health oriented physical fitness, concentration on the optimal movement performance, acquisition of knowledge about the activity, and shared positive experience. At the end of every exercise lesson, a joint performance for all interested participants was prepared. The joint performance at the end of the festival strengthened feelings of solidarity with the international community, emphasized the aesthetic experience of individual performance, and motivated the participants for continuous involvement. On the basis of these results, it is possible to conclude that the movement activities selected for the festival participants were appropriately focused on the population aged 50+.

Gymnastic programs

Apart from the health and fitness aspects, the implementation of physical activities for older population should ensure quality and safety of performed movement activities and a positive experience of the participants (Ettinger, Wright & Blair, 2007). Gymnastics significantly contributes to these aspects because it defines essential standards of movement performance, such as: conscious and directed movement must be implemented on the basis of concrete knowledge about the progression of the movement, movement must be executed by a selected technique (leading, swing, wave); every exercise has a concrete starting position which is a condition of the correct execution; all exercises have a concrete form; movement in space is executed with optimal rhythm; expression of movement is aesthetically cultivated, external form of movement respects the criterion of beauty; in a set of exercises the number of repetition and intensity are delimited; exercise should evoke positive experience of movement, activity or acquired skill, and it should bring feelings of satisfaction to the participants.

Gymnastics significantly participates in the creation of the content of necessary basic movement skills, so called physical literacy, which should be mastered by “beginners” of all ages including seniors. Conscious control of one’s body determines the ability to maintain balance in stances and positions; it also ensures that movements are performed economically and with ease in everyday situations and changing conditions. The acquisition of elementary movement skills also supports self-perception and self-awareness, an orientation ability, and empathy towards others. It also positively influences self-confidence, self-actualization, discipline, assertiveness, and an ability to express oneself through “nonverbal communication” (Dobry & Čechovská, 2010). Gymnastics for all emphasizes a specific approach which is different from competitive gymnastic sports as it is open to all interested men and women of all ages and levels of experience (Ahlquist, Russell, Fink & all., 2010). A concept labeled as 4F provides a background for the creation of the movement programs (have Fun; gain sufficient Fitness; acquire good Fundamentals; enjoy healthy Friendships). The main aim of this concept is to create and support gymnastic activities which bring positive experiences and joy to the participants, are a source for maintaining and development of physical fitness, support the acquisition of various gymnastic skills and also impact the social context of the participants.

The relation of music and movement – movement programs with music

The close relation of gymnastic movement and music is strengthened not only by the physiological effects of exercise but it also impacts the motivation to participate in movement activities, the regulation and execution of the movement in space, and it also influences the self-awareness and the experience of achievement through a completion of a movement task. Music evokes emotional reactions, influences psychological well-being and induces relaxation and concentration enabling optimal learning experience (Novotná, Brtníková & Lesmerises, 2009). In gymnastics, music initiates a movement response, mediates the movement execution, supports the cultivation of movement expression and induces creativity. Creative stimuli present in the exercise with music support individual movement improvisation which is a unique individual and motivating experience.

Music – movement composition

In music-movement compositions, individual participants join in group exercises which are based on mutual collaboration and friendship. In these exercises, every individual accepts certain social role. The group exercises in which participants come together and form larger aggregates create specific climate through movement communication and group responsibility for the performance of the composition.

In the rehearsal, preparation and performance of the composition, participants intensively experience the movement and the composition as such; they further develop their ability to experience the movement, transform it to movement expression, and transfer the emerging emotions to the audience. They feel connected with the composition and experience the success of the composition expressed by the applause from the audience as an individual success.

Our mixed-gender movement compositions performed at the festivals have always received applause from the audience and recognition from expert committees and have been selected for the final galas of the festival program.

Discussion

General gymnastic intervention programs focus on cultivation of movement basics, cultivation of movement expression, and cultivation of physical fitness. It is necessary to respect certain principles in selecting and implementing the exercises into the structure of gymnastic training for seniors. Above all, they should ensure the quality of the content of the activity. Gymnastic exercises should have a positive impact on the health of the participants, develop their fitness, and lead to conscious movement technique performed as well as possible. They should also cultivate the movement expression and aim for the beauty of the movement and its correct rhythm (possibly in harmony with music). The acquired exercise should support positive experience of movement and movement skill, incite one's personal creation of movements and movement improvisations, and bring necessary knowledge about the activity.

Conclusions

The importance of gymnastic exercises for older adults stems from the fact that at present older people express a growing need to compensate for tensions originating in coping with everyday personal, work and other social activities. Therefore, it is necessary to support the feelings of physiological and psychological balance through various forms of gymnastic exercises based on conscious and perceptible relaxation to satisfy their need of natural harmony. Group exercises with music are especially beneficial in this respect. Group exercises in which collective rhythm and tempo are shared and participants cooperate in overcoming the physical stress create good conditions for accepting group climate and shared experience of movement activity. They also reinforce an acquisition of selected movement activities as indispensable parts of active lifestyle in the older age.

It is possible to assume that gymnastic programs and movement compositions for older adults “Golden Age 50+” will further develop in a close relationship with the development of physical education and sport. We believe that our approach to the “gymnastics for all” will be further presented to the Czech and international audience and the discipline of gymnastics will continue to take part in the movement, social and aesthetic cultivation of human beings.

References

- Ahlquist, S. M., Russell, K., Fink, H. & al. (2010). *Foundation of Gymnastics*. Ruschkin: Saskatoon. ISBN 978-2-8399-0663-0.
- Dobřý, L., & Čechovská, I. (2010). Význam a místo pohybové gramotnosti v životě člověka. *Tělesná výchova a sport mládeže*, 76 (3), 2-5. ISSN 1210-7689.
- Ettinger, W. H., Wright, B. S., & Blair, S. N. (2007). *Fit po 50*. Praha: Grada Publishing.
- Haškovcová, H. (2010). *Fenomén stáří*. Praha: Havlíček Brain Team.
- Hendl, J., Dobřý, L., & et al. (2011). *Zdravotní benefity pohybových aktivit*. Praha: Karolinum. ISBN 978-80-246-8.
- Holmerová, I., Jurašková, B. & et al. (2006). Aktivní stárnutí. *Česká gerontologická a geriatrická revue*. 4 (3). 163-168.
- Junger, J, et al. (2005) Pohybová aktivita jako prostriedok kvality zlepšovania života seniorov. 202-206). In Múhlpachr, P. (ed.) *Schola Gerontologica*. Brno: MU v Brně.
- Kopřivová, J. & et al. (2002). *Cvičení pro zlepšení fyzického, ale i psychického stavu seniorů II*. Brno: HMS.
- Marcus, B. H., & Forsyth, L. H. (2010). *Psychologie aktivního způsobu života*. Praha: Portál. ISBN 978-80-7367-654-4.
- Novotná, V., & et al. (2012). *Gymnastika jako tvůrčí akt*. Praha: Karolinum. ISBN 978-80-246-2116-6.
- Novotná, V., Brtníková, M., & Lesmerises, L. (2009). Hudba jako podnět k pohybové aktivitě. In Mužík, V., & Suss, V. (Eds.) *Tělesná výchova a sport mládeže*. Brno: MU v Brně, s. 144-149. ISBN 978-80-210-4858-4.
- Riegrová, J. (2010). Hýbejme se. (43-51). In *Aktivní v každém věku IV*. Olomouc: UP.
- Sekot, A. (2008). *Sociologické problémy sportu*. Praha: Grada Publishing.
- Telo, J., Fischer, E. & Schmidt, D. (2010). *Blume Gran Canaria 50 años haciendo historia de Gimnasia*. Gran Canaria: BGC Ediciones.

Physical activity, stress, coping and life satisfaction in patients undergoing total hip replacement

Patryk Stecz, Józef Kocur

Department of Rehabilitation, Medical University of Lodz, Lodz, Poland

Abstract

The aim was to investigate the relationship between physical activity (PA), life satisfaction (LS) and stress symptoms in older patients with end-stage coxarthrosis undergoing total hip arthroplasty. It was hypothesized that baseline PA would decrease psychological stress before the surgery and was related to higher postsurgical LS. The second hypothesis claimed that sedentary behavior would be predicted by avoidance oriented coping.

In total, 70 subjects (mean age 71.0 ±6.4) completed IPAQ and Brief-COPE Carver's questionnaires before hip arthroplasty. PSS and SWLS Scales were administered before and after.

Physically active patients reported less symptoms of psychological stress ($p < .05$) and higher LS ($p < .05$). Baseline PA did not predict the magnitude of stress decrease between time one and time two. An evidence was found in regression analysis that helplessness, avoidance behavior and seeking for support comprised the weak predictors of the PA ($R^2 = .24$).

The findings constitute some rationale to direct increased efforts toward enhancing the PA among elderly individuals with musculoskeletal illnesses. Addressing the studied population for secondary prevention may help the individuals to maintain adequate LS and deal better with rehabilitation due to increasing their physical function.

Keywords: *sedentary behavior, chronic illness, ways of coping, quality of life, aging, physical activity.*

This research was supported by the Medical University of Lodz Grant no. 502-03/7-128-03/502-54-094.

Introduction

Aging process depends on the social context and is considered to be differential, however, late adulthood interacts with unspecific psychosocial transitions of the individual, i.e. retirement, decrease of body function, multimorbidity or mental disorders (Morgan

and Kunkel, 2001). These factors impede the physical activity (PA) participation which consequently is thought to be insufficient in the aging population (Haley and Andel, 2010). Osteoarthritis (OA), one of the major chronic joint diseases, is related to loss of physical function, rising prevalence of motor disability and might result in maladjustment in terms of social withdrawal (Bijlsma et al., 2011).

Moderate physical exercise is regarded to be substantial for preventing from rapid development of disabling conditions and chronic disease in late adulthood (Chodzko-Zajko et al., 2009). Concerning OA management, regular PA is found to be the effective strategy despite the sedentary lifestyle of the target group (Bossen et al., 2013). Physical inactivity in long-term aspect is known to be associated with secondary aging issues such as environmental stress and diseases of affluence (Booth et al., 2011). The neurochemical and hormonal responses to stress transaction play an important role in developing health problems (i.e. hypertension, dermatitis, allergic reactions) and psychological conditions such as anxiety or depression (Morgan and Goldston, 1987). Biochemical research performed on human indicated the relationship between physical exercise and central serotonin which was found to enhance the mood (Chaoulhoff, 1997). Physiologically, the acute exercise results in the increase of bodily temperature, changes in cerebral blood flow and triggers the muscle relaxation which is implemented in relaxation techniques. The evidence to support the physiological hypotheses are inconsistent though (Koltyn, 1997). Psychosocial range of benefits yielded from PA is related to self-esteem, self-efficacy and social participation. Studies emphasize the positive role of social support received through the group interactions induced by leisure activities, as well as self-perception enhancement through increasing mobility and independence (Fox, 1999). Alternatively, some reports have shown that excessive physical exercise, vigorous sports and hard, physically demanding work overstraining the joints could induce the OA development (Michaelsson et al., 2011; Sulsky et al., 2012). Additionally, the general focus of the research regarding the relationship between PA and OA is shifted to the consequences in terms of disease development (Ageberg et al., 2012) while the present study investigates the influence of PA on psychological markers of health and subjective well-being which is not underestimated in biomedical approach.

Studies investigating the psychological factors that may predict the OA patients' health related quality of life take into account the significance of coping strategies and self-efficacy. As previously suggested, the OA patients' self-efficacy might be mediated by the physical function, while coping styles were found to have prognostic value of OA outcome. The review performed by Benyon et al. (2010) on studies with OA samples confirmed that both problem and avoidance oriented coping predicted worse emotional functioning, which we consider to be potentially detrimental to the

patient's self-perception and increase the risk of maladaptive reactions or behavioral patterns. Coping reactions focused on feeling helpless were shown to be associated with physical impairment and pain in OA population (Somers et al., 2009). The uncertain role of coping strategies for both physical and psychological function in OA highlights the need for research investigating the predictive value of coping for physical performance in the group of coxarthrosis patients which is specific and vulnerable to disability more than the general older adults population.

Adversely to the Cumming and Henry's disengagement theory, Bee and Boyd (2007) indicated that older adults were not observed to decline in social role participation and relationships unless their disability affected motoric skills. By reason of OA progress, the psychosocial results include withdrawal, depression, anxiety and stress associated with catastrophizing or passive adjustment (Axford et al., 2010; Benyon et al., 2010).

The goal was to answer the question whether baseline PA was associated with stress perception and LS in patients undergoing total hip replacement (THR). We hypothesized that the PA could also predict the magnitude of stress reduction and increment of LS. To formulate the second purpose of this study, we referred to the theoretical concept of relationship between ineffective coping and unhealthy behavior. Catastrophizing, passive coping or self-blame are linked to the substance use and confrontation avoidance while effective coping may enhance self-management or focusing on treatment by compensation strategies (Heszen and Sk, 2012). It is expected, that problem focused style may be beneficial in terms of the patient's initiative and active cooperation. PA enables the patient to control body weight or reduce obesity and could be the one of potential resources sustaining social participation, self-efficacy and independence. Thus, we expected, that avoidance oriented coping predicted sedentary behavior before THR.

Methods

A total of 70 subjects (mean age 71.0 ± 6.4), out of 102 patients indicated to participation in the longitudinal study, successfully completed the procedure. Patients responded to self-report questionnaires at two time points: one day before the THR during the admission to the hospital and three months after. The study has been approved by the local bioethics committee. A written consent was obtained from all the patients indicated to the study. The authors' survey recorded the socioeconomic information (age, marital status, employment, economic situation, education). Patients with revisions, other diagnosis than OA (i.e. rheumatoid arthritis) and major cognitive impairments (i.e. dementia) were excluded. At time one, we collected data with the following measure instruments: The International Physical Activity Questionnaire,

Brief-COPE Carver's questionnaire, Satisfaction with Life Scale and Perceived Stress Scale. Three months after the hip arthroplasty we examined the subjects with Satisfaction with Life Scale and Perceived Stress Scale.

Measurement tools

Perceived Stress Scale. The instrument, introduced by Cohen et al. (1983), is a self-administered questionnaire assessing the individual's perception of stress in last month. The total score is obtained by the respondents answering 10 questions, using a 5-point Likert scale. An internal reliability coefficient was reported to be satisfactory for the Polish validation (Juczyński and Bulik, 2009). The Cronbach's alpha in our sample was equal to .90 (negative statements) and .87 (positive statements) for pretest and ranged from .82 to .88 in retest.

Satisfaction with Life Scale. The questionnaire was developed by Diener et al. (1985) to measure the person's overall judgment of his or her subjective well-being. The individual responds to 5 self-administered questions on 7-point scale comprising the one-dimensional result on LS. The reliability coefficient for the Polish validation was .81 (Juczyński, 2009). The Cronbach's alpha in our sample was .86 for pretest and .88 for retest.

Brief-COPE is a cost-effective questionnaire, a short version of COPE, created by Carver (1997) in order to measure the ways of dealing with stress in the clinical samples, which are more vulnerable to fatigue. Some theories of coping underline that the individual is likely to use the typical range of coping behaviors comprising the pattern or style. For that reason, we administered the dispositional version. In total, each pair out of 28 four-point scale items create a separate dimension indicating the following 14 styles: active coping, planning, positive reframing, acceptance, seeking for instrumental support, seeking for emotional support, behavioral disengagement, denial, venting, use of psychoactive substance, self-blame, humor, self-distraction, religion. The Polish validation introduced four additional coping dimensions, matching two or more of the abovementioned scales. The distinguished dimensions included: active coping, helplessness, seeking for support and avoidance behavior. Alpha Cronbach's coefficients for Brief-COPE in our sample ranged from .71 to .90 except of self-distraction (.30) and venting (.57).

International Physical Activity Questionnaire (IPAQ) is an international measurement tool developed to assess the PA in three categories: low intensity PA, moderate intensity PA and vigorous PA. The scoring procedure enables to transpose the subject's result of time spent for each type of activity in the last week into the Metabolic Equivalent of Task (METs). 1 MET is described as 1kcal/kg/hour, while 1 MET/min is equivalent to 3.5 ml O₂/kg of body mass/min burned during PA.

According to the authors' distinction, there are three types of PA: low (insufficient), moderate and high. Briefly, the authors suggest that the individual can be characterized as sufficiently active (or with moderate PA) if the combination of his or her daily activities achieves 600 MET-mins per week or more. The short form of IPAQ has good test-retest reliability according to the evaluation of the questionnaire performed in 12 countries (Craig et al., 2003).

Statistical analyses. We tested the relationships with Pearson correlation analyses while the mean differences were tested with t-test statistics. We computed repeated measures split-plot ANOVA to compare the degree of stress reduction and LS improvement between low- and high- PA groups. In order to indicate the predictors of PA, we formulated the linear regression model using stepwise technique. The statistics were performed with IBM SPSS v 20.

Results

Descriptive statistics Briefly, the sample was predominantly on retirement (62.9%), married or in relationship (54.3%) and female (55.7%). It was reported that 34.3% of the sample was widowed and 11.4% was single or divorced. The number of subjects with disability pension was 22.9% while the number of employed respondents was 8.6%. The majority of the sample obtained primary or vocational education (65.7%), while 25.7% graduated from secondary/post-secondary school and 8.6% obtained the university level. Approximately 32.9% of the sample was unsatisfied or very unsatisfied with their economic situation. It was found that 41.7% of the subjects were neutral about their economic situation and 25.8% of the sample was satisfied or very satisfied.

Data analysis The mean value of PSS pretest score was 15.33 (SD=6.79), respectively 14.20 (SD=6.12) for PSS retest. Mean result for LS measured by SWLS before THR was 21.19 (SD=5.92) while after the surgery its value was 22.26 (SD=6.04). We indicated that the METs per week mean score of the sample before THR was 1398.83 (SD=1596.74). Overall, the respondents' PA was insufficient (41.4%) against 30.0% of the respondents with sufficient PA and 28.6% of the subjects with high PA. The detailed criteria for scoring and categorizing the respondent's result into one out of three clusters is based on the recommendations available in the literature (Ainsworth et al., 2000).

The results revealed significant associations between baseline PA expressed in METs-week and psychological indicators for females. The correlations included stress perception before the surgery ($r=-.38$, $p<.05$), perceived stress in three months follow up ($r=-.31$, $p<.05$) and LS in three months follow up ($r=.27$, $p<.05$). The relationship

between PA and psychological function in the entire sample was inconclusive (p values for perceived stress varied from .055 to .058).

To answer the question whether the subgroup of subjects reporting the most sedentary lifestyle ($n_x=21$; IPAQ score <300 METs per week) were characterized as psychologically maladaptive when comparing with sufficiently active subjects ($n_y=49$; IPAQ score >300 METs per week), we performed t-test statistics. The mean results on perceived stress scale before [$M(x-y)=4.21$, $t=2.500$, $df=68$, $p=.015$] and after [$M(x-y)=4.00$, $t=2.637$, $df=68$, $p=.010$] the surgery were higher in the inactive subsample.

In order to test how stress perception changed after the surgery between subjects with insufficient and sufficient PA, we performed General Linear Model (split-plot ANOVA). Group x consisted of the individuals with low PA (below 300 METs-week) and group y consisted of subjects with PA above 300 METs-week. Regarding stress perception, the marginal means for group x were 17.85 (PSS pretest score, $SE=1.49$) and 16.50 (PSS pretest score PSS, $SE=1.33$) against 14.32 (PSS pretest score, $SE=.94$) and 13.28 (PSS posttest score, $SE=.85$) for group y. PA did not affect the magnitude of stress decrement after the surgery between groups x and y ($F=.12$, Wilks $\lambda=1.00$, $df=1$, $p>.05$, eta square=.002). Both groups reported a significant decrease of perceived stress, tough ($F=6.98$, Wilks $\lambda=.91$, $df=1$, $p<.05$, eta square=.09). Between-subjects effect was confirmed which means that the groups with varying PA were found to have different mean values both before and after THR [$F=4.39$ ($df=1$) partial eta square=.06, mean square=325.45, $p<.05$].

Similarly, we compared the magnitude of LS improvement between groups x and y. The marginal means for group x were 18.70 (pretest score on SWLS, $SE=1.29$) and 19.85 (posttest score on SWLS, $SE=1.32$) against 22.18 (pretest score on SWLS, $SE=.81$) and 23.22 (posttest score on SWLS, $SE=.83$) for group y. The increase of LS was not found to be greater in any group ($F=.08$, Wilks $\lambda=1.00$, $df=1$, $p>.05$, eta square=.001). Yet, the mean differences in LS between groups were found to remain significant both before and after the surgery (between-groups effects: $F=5.04$, $df=1$, partial eta square=.07, Mean square=335.16, $p<.05$). The within-group and between-group effects were presented in Figure 1.

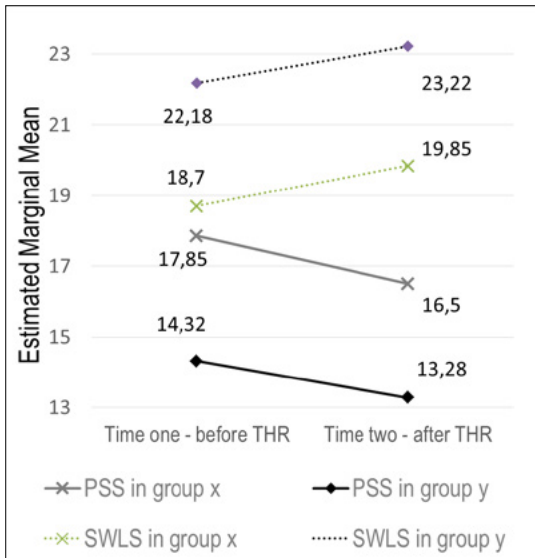


Fig. 1 Marginal mean differences in psychological variables at time one and time two between subjects with low and high physical activity.

Linear regression model [$F=6.04$ ($df=3$), Mean sq=15905390.00, $p<.01$, $R^2=.22$] with PA as dependent variable and coping styles as independent variables has revealed the explanatory variables: helplessness ($Beta=-.64$, $t=-3.86$, $p<.0005$, $B=-336.39$, $SE=87.28$), seeking for support ($Beta=-.37$, $t=-3.15$, $p<.01$, $B=-257.84$, $SE=81.84$) and avoidance behavior ($Beta=.47$, $t=2.95$, $p<.01$, $B=252.76$, $SE=85.84$). In the stepwise regression algorithm we removed active coping which was found to be insignificant predictor in the model.

Discussion

It was found that about half the OA sample reported insufficient PA, which could be explicated by the findings of Arokoski et al. (2004) that individuals with hip OA report worse results on physical function scales than individuals of similar age without coxarthrosis. It is widely reported that older adults in general are the group of least PA and the highest expenditures for healthcare, which is the matter of public concern (Nelson et al., 2007).

Overall, avoidance behavior was found to be the predictor of sufficient PA, while seeking for support and helplessness were found to be the predictors of insufficient

PA. Unfortunately, our model failed to determine the relationship between active coping and higher PA. The results were somewhat surprising, as we expected the negative relationship between avoidance coping and PA. However, the model fits only to a small fraction of the total variance of PA, which means that coping strategies were quite weak predictors of participation in physical exercise. Additionally, a longitudinal study performed by Groux et al. (1992) has shown that the individuals may deal with stress through active distraction (e.g. exercise). Another example of how avoidance coping predicts higher PA can be shown by the findings of Murphy et al. (2012). They observed that the OA individuals reported higher PA if their avoidance coping strategies included asking for guidance.

Helplessness was found to predict sedentary behavior among older adults with arthritis. Similarly, Bhat et al. (2010) have found that helplessness was related to disability, furthermore it predicted the symptoms of pain. Elderly people with low expectation that the PA would improve their health are unlikely to participate frequently in leisure and sport activities (Resnick, 2003).

It was partially confirmed that PA was associated with lesser stress perception before and after THR. The findings from the literature are controversial in this topic. Although some researchers agree that PA has no association with developing OA symptoms (Ageberg et al., 2012), it is not explicit whether PA has significantly beneficial effect in well-being and stress reduction (Scully et al., 1998). Only the subjects with the lowest PA (below 300 METs/week) were found to feel more stressed, which suggests that this portion of the studied sample could experience the secondary stressful consequences of sedentary lifestyle, including the impaired physical function, social dependency or withdrawal.

The split-plot ANOVA statistics revealed that the individuals with insufficient PA reported improvement of LS after the surgery and its degree did not vary among physically active subjects. We also observed that the LS of sedentary patients remained significantly lower after the surgery when compared with the subjects with higher baseline PA. This means that the LS enhancement through THR and rehabilitation was significant but the patients' LS remained unequal each according to the initial PA. This phenomenon might be related partially to the fact that sedentary behavior in OA is strongly associated with obesity, which is found to be one of the major correlate of negative functional status after the THR (Bischoff-Ferrari et al., 2004).

We consider that the limitation of this study was the relatively small number of psychosocial variables and medical records so that it could not provide the complex associations between stress, PA and coping in OA. Anyhow, the number of factors determining physical and psychological function of the chronically ill patients is known to be exhaustive, not to mention self-efficacy, social-support, personality traits,

mental disorder or pain interpretation (Bischoff-Ferrari et al., 2004, Sunden et al., 2013). Therefore, we focused primarily on direct relationships between coping styles, PA, stress perception and subjective LS.

Conclusion

1. PA is associated with lower perceived stress before and after THR, which is found by the OA patients to be stressful event.

2. Life satisfaction increases after THR, although the OA patients with low baseline PA are unlikely to approximate to sufficiently active patients' life satisfaction after the surgery.

3. Avoidance oriented coping, helplessness and seeking for support comprise the weak predictors of PA in OA patients.

4. A significant number of physically inactive patients in OA population may be indicated.

References

- Ageberg, E., Engstrom, G., Gerhardsson de Verdier, M., Rollof, J., Roos, E. M., & Lohmander, S. L. (2012). Effect of leisure time physical activity on severe knee or hip osteoarthritis leading to total joint replacement: a population-based prospective cohort study. *BMC Musculoskeletal Disorders*, 13, 73.
- Ainsworth, B. E., Bassett, D. R., Strath, S. J., Swartz, A. M., O'Brien, W. L., Thompson, R. W., Kimsey, C. D. (2000). Comparison of three models for measuring the time spent in physical activity. *Medicine & Science in Sports & Exercise*, 32(9 Suppl), 457-464.
- Axford, J., Butt, A., Heron, C., Hammond, J., Morgan, J., Alavi, A., Bland, M. (2010). Prevalence of anxiety and depression in osteoarthritis: use of the Hospital Anxiety and Depression Scale as a screening tool. *Clinical Rheumatology*, 29, 1277-1283.
- Benyon, K., Hill, S., Zadurian, N., & Mallen C. (2010). Coping strategies and self-efficacy as predictors of outcome in osteoarthritis: a systematic review. *Musculoskeletal Care*, 8(4), 224-236.
- Bijlsma, J. W., Berenbaum, F., & Lafeber, F. P. (2011). Osteoarthritis: an update with relevance for clinical practice. *Lancet*, 377, 2115-2126.
- Bischoff-Ferrari, H. A., Lingard, E. A., Losina, E., Baron, J. A., Ross, E. M., Phillips, C. B., Katz, N. (2004). Psychosocial and geriatric correlates of functional status after total hip replacement. *Arthritis Care & Research*, 51(5), 829-835.
- Bhat, A. A., DeWalt, D. A., Zimmer, C. R., Fried, B. J., and Callahan, L. F. (2010). The role of helplessness, outcome expectation for exercise and literacy in predicting disability and symptoms in older adults with arthritis. *Patient Education and Counseling*, 81(1), 73-78.
- Booth, F. W., Laye, M. J., & Roberts, M.D. (2011). Lifetime sedentary living accelerates some aspects of secondary aging. *Journal of Applied Physiology*, 111(5), 1497-1504.
- Bossen, D., Veenhof, C., Dekker, J., & de Bakker, D. (2013). The usability and preliminary effectiveness of a web-based physical activity intervention in patients with knee and/or hip osteoarthritis. *BMC Medical Informatics and Decision Making*, 13, 61-68.

- Carver, C. S. (1997). You Want to Measure Coping But Your Protocol's Too Long: Consider the Brief COPE. *International Journal of Behavioral Medicine*, 4(1), 92-100.
- Chaouloff, F. (1997). The serotonin hypothesis. In: Morgan, W. P. (ed.) *Physical Activity and Mental Health*. Washington, Taylor & Francis, 179-198.
- Chodzko-Zajko, W., Schwingel, A., & Park, C. H. (2009). Successful Aging: The Role of Physical Activity. *American Journal of Lifestyle Medicine*, 3(1), 20-28.
- Craig, C. L., Marshall, A. L., Sjoström, M., Bauman, A. E., Booth, M. L., Ainsworth, B. E., Oja, P. (2003). International physical activity questionnaire: 12-country reliability and validity. *Medicine & Science in Sports & Exercise*, 35, 1381-1395.
- Cohen, S., Karmarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behaviour*, 24, 385-396.
- Diener, E., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The Satisfaction with Life Scale. *Journal of Personality Assessment*, 49, 71-75.
- Fox, K. R. (1999). The influence of physical activity on mental well-being. *Public Health Nutrition*, 2(3a), 411-418.
- Grou, M. W., Thomas, S. P., Shoffner, D. (1992). Adolescent stress and coping: A longitudinal study. *Research in Nursing & Health*, 15(3), 209-217.
- Haley, C., & Andel, R. (2010). Correlates of Physical Activity Participation in Community-Dwelling Older Adults. *Journal of Aging and Physical Activity*, 18(4), 375-389.
- Heszen, I., Sęk, H. (2012). *Psychologia Zdrowia*. [Health Psychology]. Warsaw, Wydawnictwo Naukowe PWN.
- Juczyński, Z (2009). SWLS- Skala Satysfakcji z Życia (adaptacja: Z. Juczyński). [SWLS-Satisfaction with Life Scale (adaptation: Z. Juczynski)]. In Z. Juczynski, (Ed.), *Narzędzia Pomiaru w Promocji i Psychologii Zdrowia*, Warszawa, Pracownia Testów Psychologicznych.

Juczyński, Z., & Ogińska-Bulik, N. (2009). PSS-10 Skala Odczuwanego Stresu (adaptacja: Z. Juczyński i N. Ogińska-Bulik). [PSS-10 Perceived Stress Scale (adaptation: Z. Juczynski and N. Oginska-Bulik)]. In Z. Juczynski, N. Oginska-Bulik (Eds.), *Narzędzia Pomiaru Stresu i Radzenia Sobie ze Stresem*, Warszawa, Pracownia Testów Psychologicznych.

Koltyn, K. F. (1997). The thermogenic hypothesis. In: Morgan, W. P. (ed.) *Physical Activity and Mental Health*. Washington, Taylor & Francis, 213-226.

Michaelsson, K., Byberg, L., Ahlbom, A., Melhus, H., Farahmand, B. Y. (2011). Risk of Severe Knee and Hip Osteoarthritis in Relation to Level of Physical Exercise: A Prospective Cohort Study of Long-Distance Skiers in Sweden. *PLoS ONE*, 6(3), e18339, 1-8.

Morgan, L., & Kunkel, S. (2001). *Aging. The social context*. London, SAGE Publications Ltd.

Morgan, W. P., & Goldston, S. E. (1987). *Exercise and mental health*. New York, Hemisphere Publishing Corporation.

Murphy, S. L., Kratz, A. L., Williams, D. A., & Geisser, M. E. (2012). The association between symptoms, pain coping and physical activity among people with symptomatic knee and hip osteoarthritis. *Frontiers in Psychology*, 3(326), 1-12.

Nelson, M. E., Rejeski, W. J., Blair, S. N., Duncan, P. W., Judge, J. O., King, A. C., Castaneda-Sceppa, C. (2007). *Physical Activity and Public Health in Older Adults: Recommendation from the American College of Sports Medicine and the American Heart Association*. *Medicine and Science in Sports & Exercise*, 39(8), 1435-1445.

Resnick, B. (2003). The theory of self-efficacy. (In:) Smith, M. J., Liehr, P. R. (Eds.) *Middle range theory for nursing*. New York: Springer Pub.

Scully, D., Kremer, J., Meade, M. M., Graham, R., & Dudgeon, K. (1998). Physical exercise and psychological well-being: a critical review. *British Journal of Sports Medicine*, 32, 111-120.

Somers, T. J., Keefe, F. J., Pells, J. J., Dixon, K. E., Waters, S., Riordan, P. A., Rice, J. R. (2009). Pain catastrophizing and pain-related fear in osteoarthritis patients: Relationship to pain and disability. *Journal of Pain and Symptom Management* 37, 863-872.

Sulsky, S., Carlton, L., Bochmann, F., Ellegast, R., Glitsch, U., Hartmann, B., Sun, Y. (2012). Epidemiological Evidence for Work Load as a Risk Factor for Osteoarthritis of the Hip: A Systematic Review. PLoS ONE, 7(2), e31521, 1-13.

Sunden, A., Ekdahl, C., Magnusson, S. P., Johnsson, B., & Gyllensten, A. L. (2013). Physical function and self-efficacy – Important aspects of health-related quality of life in individuals with hip osteoarthritis. European Journal of Physiotherapy, 15(3), 151-159.

SPORTS TRAINING, PROFESSIONAL SPORT

The influence of modified warm up on 100m Freestyle swimming performance

Andrew Thomas and James Goodwin

Faculty of Life Sciences and Education, University of South Wales, Newport, United Kingdom

Abstract

Research into the effects of warm up has provided sports scientists and coaches with understanding of the best methods for preparing the athlete to achieve peak sporting performance. Where athletes can engage in a process of uninterrupted warm up and competition, the theory of warm up can be shown to be most effective by utilising the best mode, duration and intensity for preparation. However, not all sports competitions provide athletes with a smooth transition from the warm up to the sporting event. This is evident in competitive swimming where swimmers may have a prolonged period of waiting between warm up periods and their competition. During this time the positive effects of the warm up period may have dissipated. 19 age group swimmers [Age (yrs) M 16.21 SD 3.51, Height (m) M 1.76 SD 0.09, Weight (kg) M 61.40 SD 12.91] used a cross over design to elicit the performance times of a 100m freestyle time trial using two warm up protocols. The swimmers were randomly assigned into two different groups and required to complete different warm up protocols with a following associated time trial. Warm up protocol 1 required the swimmers to carry out a standardised warm up in the pool (2000 m) and then complete a time trial following a set period of rest (40 minutes). Warm up protocol 2 was similar to protocol 1 but engaged swimmers in a 5 minute period of dry land activities 20 minutes before the time trial. Swimmers heart rate and body temperature were recorded at set times during the protocol along with swimming performance times to monitor the effect of warm up protocols. For warm up protocol 1 swimmers' body temperature and heart rate reduced by 0.50 °C ($p < 0.01$) and 82.05 bpm ($p < 0.01$) respectively. Whilst heart rate fell following warm up protocol 2, body temperature continued to rise to 0.14 °C ($p < 0.01$) higher than after the warm up protocol 1. The time trial results showed improved performance times following the warm up 2 protocol (0.25 sec $p < 0.01$). It is suggested that additional land activities prior to the time trial, contributed to maintaining a higher body temperature, thus priming muscle metabolism ready for exercise. As a consequence the fatigue process has been delayed allowing for improved performance times. The contribution from anaerobic / aerobic energy pathways has not been established due to the requirement for additional sports science investigation, although this is an area of future interest.

Keywords: *Warm up, Swimming, Performance.*

Introduction

It is commonly accepted that athletes benefit from the engagement of pre-competition warm up activities. These activities help prepare the athlete to become accustomed to the competition environment, rehearse specific movement patterns and promote physiological changes to enhance performance. The nature of warm up activity is specific to the sport being performed and the environment in which it takes place. For instance, gymnasts engage in prolonged stretching routines to increase mobility and football players perform running activities at various speeds with multiple changes of direction. Furthermore, the environment of a heated gymnasium and an outdoor football stadium highlight the different conditions in which warm up and competition take place. Competitive swimmers also have a unique environment in which their warm up routines take place, which is normally in a rectangle 25m or 50m pool with standardised water temperature and lanes to separate individual swimmers. Within an individual sport there are sub categories such as playing position, distance and the use of equipment that also contribute the type of warm up that the athlete engages in. For example: a scrum half and a winger in rugby union; a 100m and 1500m runner in track athletics; single and paired sculls in rowing. Each of these sub categories have specific warm up routines that prepare the athlete for competition. Competitive swimming is not dissimilar with this regard and coaches will design warm up routines to prepare swimmers for their specific event.

Nevertheless, a particular problem exists within certain sports where there is a prolonged period of time between the cessation of the warm up activities and the engagement of competition. This delay may offset the benefits of the warm up activity by allowing the physiological responses to return to pre warm up levels. In competitive swimming the potential for this situation to occur is promoted due to the competition organisation arrangements. Before racing swimmers are required to report to a 'call room' which under FINA rules necessitates them to register 20 minutes before the start of their event (FINA, 2013). With a swimming session made up of several events and events made up of several heats the time between warm up and competition may be extended to 2 hours in some cases. In order to explore the benefit of maintaining elevated body temperature and thus the physiological benefits of warming up, an adapted warm up protocol that incorporated additional land exercises was introduced prior to completing a 100m Freestyle time trial.

Method

The process of recruitment was initiated, following ethical approval, with participants being invited to complete a pre-test question to determine their suitability and fitness to participate. Due to the age of the participants parental consent was sought in addition to the participant's permission to part take in this study. Informed consent was provided giving detailed information relating to the nature of the testing protocol. The participants selected for inclusion of the trial were all at Welsh National swimming performance level, currently completing 15 hours of pool training per week and had 3 years competition experience. The sample population comprised of 19 swimmers (12 males and 7 females). The participants' characteristics were Age (yrs) M 16.21 SD 3.51, Height (m) M 1.76 SD 0.09, Weight (kg) M 61.40 SD 12.91. Males only Age (yrs) M 16.33 SD 3.03, Height (m) M 1.79 SD 0.92, Weight (Kg) M 66.07 SD 13.00. Females only Age (yrs) M 16.00 SD 4.47, Height (m) M 1.69 SD 0.67, Weight (Kg) M 53.40 SD 8.52.

In order to standardise the swimmers physical preparation for the testing protocol, they all completed a training session 48 hours prior to the time trial, which was designed to deplete glycogen stores (Maglischo, 2003). The training session included 8 x 100m maximal effort swims with a 4 minute turnaround time. In addition, the swimmers were instructed to have at least 6 hours night sleep prior to day of testing, to eat a small meal high in carbohydrate and low in fat at least two hours before testing session (Gurd et al., (2006).

An adapted standardised 2000m warm up was used for both warm up protocols (Maglischo, 2003). The warm up, which was specific to front crawl sprint swimming, included a combination of front crawl and backstroke using various distances and pacing strategies. There was a 40 minute period between the completion of the warm up and the start of the time trial. This 40 minute period was intended to replicate the average period of time competitors spend between their warm up and competition during which swimmers change swimwear and move through the call room requirements. The swimmers were randomly appointed to two groups and using a cross over design, required to complete two 100m freestyle time trials using two different warm up protocols which were conducted two weeks apart. Warm up protocol 1 required the swimmers to complete the standardised 2000m swim and then complete the 100m Freestyle time trial. Protocol 2 introduced a 5 minute period of land exercises which included fast rope skipping, explosive jumps and fast press ups 20 minutes before the time trial (fig 1.)

Anthropometric measurements of participants' height were taken on poolside prior to warming up using a Charder HM200P Portstad Portable Stadiometer and their body

mass measured using a WB-100A Digital Scale. Physiological measurements of heart rate and body temperature were taken at three defined points in the testing protocol. These points were before the warm up, on completion of the warm up and lastly prior to the time trial (fig 1.). Heart rates were taken using Polar heart rate S610 monitors and body temperature was taken using a Radiant TH809 series infrared ear Thermometer.

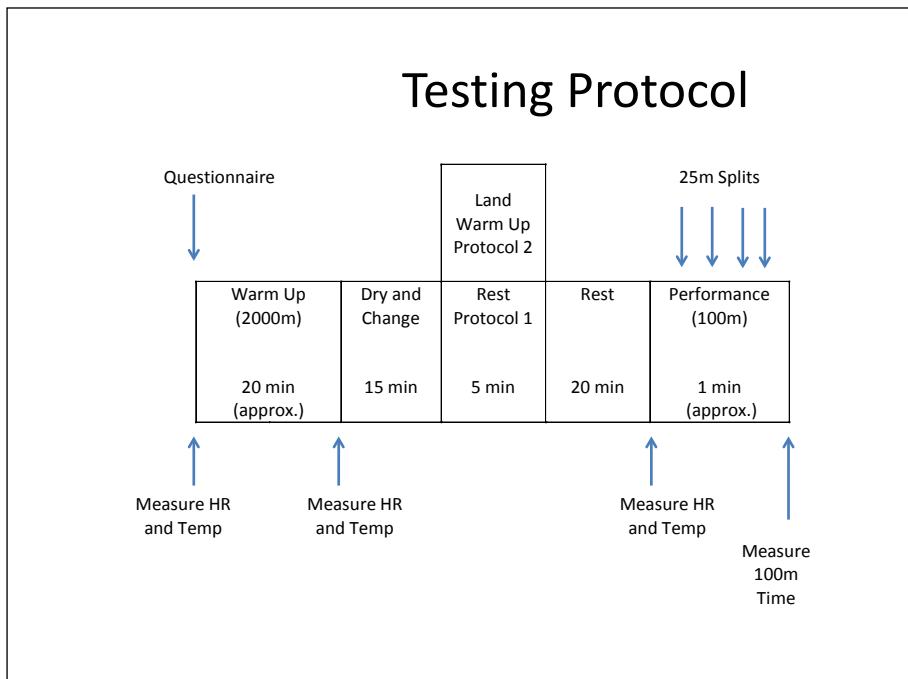


Fig. 1 Schematic representation of testing protocol

The 100 m Freestyle time trial was performed in a 25 m pool which had a fixed pool depth of 2 metres and set up with anti-turbulence lanes. The water temperature was recorded at 28.20 °C and an air temperature of 30.60 °C. Swimmers performed a track racing dive from regulation starting blocks at the beginning of the trial and were started using normal racing procedures. Manual timing of the swim was made via two qualified officials who used Seiko S141 stopwatches and an average of the split times for each length and total time were recorded. Swimmers all preformed tumble turns and therefore split times on 1st, 2nd and 3rd lengths were taken once the

feet had touched the wall. Once the time trial was completed the swimmers were directed through a 1200 m cool down to alleviate muscle soreness and blood pooling (Maglischo, 2003). Statistical analysis of the data collected was made using SPSS v18 and used a series of dependant samples t-tests (two-tailed) to examine the differences in physiological function and swimming performance.

Results

The results showed that following the standardised warm up, swimmers heart rate and core body temperatures rose significantly ($p < 0.01$) from resting values for both protocols. These changes are shown in table 1 and highlight an 89 bpm and 96 bpm increase in heart rate during protocol 1 and 2 respectively. Similar changes in core body temperature were also observed between protocol 1 and 2 showing increases of 0.47°C and 0.54°C respectively. In addition, no significant difference in the pre warm up heart rates or core body temperatures, before and immediately after the standardised warm up was found when comparing these values between the two time trials (table 1). However, significant differences were established for in heart rate and core body temperature between warm up protocol 1 and 2 prior to the time trial (table 1). There was a significant difference between the heart rates of protocol 1 and 2 where $t_{crit} = 8.72$ ($p < 0.01$). Furthermore this level of significance was found for changes in core body temperature between the two protocols where $t_{crit} = 6.76$ ($p < 0.01$).

Tab. 1 Comparison of heart rates and Core body temperatures between warm up protocol 1 and 2

		Warm Up 1 M (SD)	Warm Up 2 M (SD)	t_{crit}	Significance
Before Warm Up	Hr (bpm)	52.47 (5.57)	51.26 (3.84)	1.81	$p > 0.10$
	Temp ($^{\circ}\text{C}$)	37.38 (0.74)	37.28 (0.50)	1.13	$p > 0.10$
After Warm Up	Hr (bpm)	142.42 (11.13)	143.95 (11.33)	0.52	$p > 0.10$
	Temp ($^{\circ}\text{C}$)	37.86 (0.63)	37.82 (0.53)	0.36	$p > 0.10$
Before Time Trial	Hr (bpm)	60.37 (9.66)	74.11 (8.92)	8.72	$p < 0.01$
	Temp ($^{\circ}\text{C}$)	37.28 (0.50)	37.96 (0.30)	6.76	$p < 0.01$

The time trial results showed that swimmers on average completed their swim 0.25 second faster following completion of warm up protocol 2. The mean time trial result for following protocol 1 was 59.71 (3.33) seconds and for protocol 2 was 59.46

(3.37) seconds. The difference in these times was found to be significant with $t_{crit} = 3.40$ ($p < 0.01$). However, no significant difference was found between the individual length split times ($p = 0.10$). Fig 2 shows the comparison of the split times between the different protocols and shown that only during length 3 are the swimmers on average faster during protocol 2.

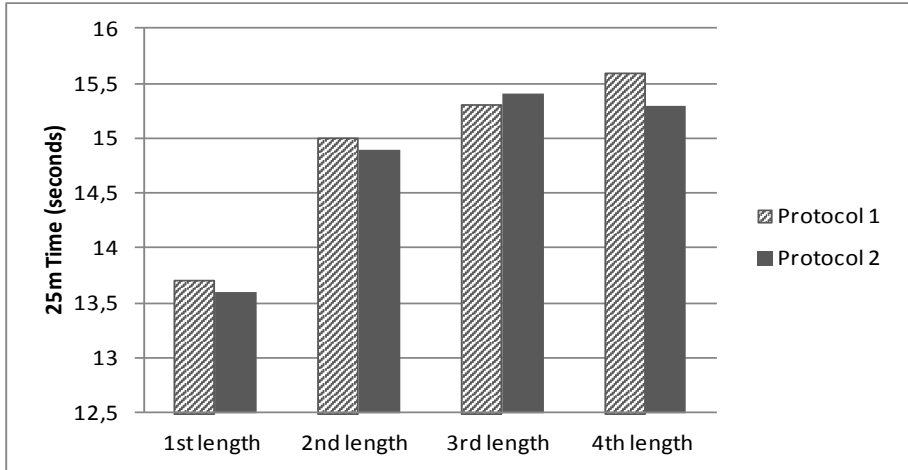


Fig. 2 Comparison of split 25m swimming times between protocol 1 and 2 Discussion

In sprint swimming thousands of a second can separate medal winners as was seen in the 2011 World Championships where 0.05 seconds decided the bronze and silver medallists in the 100m freestyle (FINA, 2011). Therefore, the improved swimming performance of 0.25 second that resulted from following protocol 2 is highlighted as a substantial improvement in performance terms. In this protocol swimmers engaged in additional active high intensity explosive land exercises 20 minutes before the 100m time trial. Although there was no significant difference in heart rate between the two protocols prior to the time trial, protocol 2 produced higher core temperature in the swimmers ($p < 0.01$).

It is proposed that the improvement in swimming speed may be attributed to maintaining an elevated core body temperature and associated temperature related mechanisms. These mechanisms include greater release of O₂ from haemoglobin and myoglobin, increased metabolic reactions and nerve conduction rate increases (Bishop, 2003). McCutcheon (1999) reports that O₂ carrying capacity to muscles increases following warm-up resulting in a shift in the oxyhaemoglobin dissociation curve to

the right and increased vasodilation of muscle blood vessels. Furthermore, Febbraio et al., (1999) demonstrated the positive effect of increased muscle temperature on glycogenolysis, glycolysis and high energy phosphate degradation. Research has established that increased muscle temperature has a positive effect on the transmission speed of the central nervous system(Karvonen, 1992). Some caution should be made with the construction of the warm-up for as Genovely and Stamford (1982) highlight prolonged high intensity warm-up may have negative effects on performance by reducing muscle glycogen levels and effectiveness of fast twitch muscle fibre action. Therefore, a balance needs to be made between increasing core and muscle temperature and not providing too high a stimulus over a protracted period so that fatigue processes are initiated.

Conclusions

If this proposition, that elevated core body temperature is a contributory factor to enhanced performance, in sprint 100m freestyle swimming, it may have considerations for how coaches and swimmers prepare themselves for competition. Therefore, if there is an extended period of time between cessation of the pool warm up and the competition then conducting specific land exercise to maintain core temperature may be a way of enhancing physiological function during the competition. However, there is an element of caution in that more research would need to be conducted to establish the optimal level of core or muscle temperature and the duration of the warm up so as not to cause negative effects to the performance.

References

- Bishop, D. (2003). Potential Mechanisms and the Effects of Passive Warm Up on Exercise Performance. *International Journal of Sports Medicine*, 33 (6), pp. 439-454.
- Febbraio, M. A., Carey, M. F. and Snow, R. J. (1996) Influence of elevated muscle temperature on metabolism during intense, dynamic exercise. *American Journal of Physiology*. 271(40) pp. 1251-1255.
- FINA (2009) SW 3 Seeding of Heats, Semi-Finals and Finals. Available at: http://www.fina.org/H2O/index.php?option=com_content&view=article&id=280:sw-3-seeding-of-heats-semi-finals-and-finals&catid=82:swimming-rules (Accessed 25 September 2013).
- FINA (2011) Shanghai 2011 results. Accessed at: [fina.org/H2O/index.php?option=com_wrapper&view=wrapper&Itemid=1100](http://www.fina.org/H2O/index.php?option=com_wrapper&view=wrapper&Itemid=1100). (Accessed 19th August 2011).
- Genovely, H. and Stamford, B. A. (1982) Effects of prolonged warm-up exercise above and below anaerobic threshold on maximal performance. *European Journal of Applied Physiology*. 48 (3) pp. 323-330.
- Gurd, B., Peters, S., Heigenhauser, G., Leblanc, P., Doherty, T., Paterson, D. and Kowalchuk, J. (2006) Prior heavy exercise elevates pyruvate dehydrogenase activity and speeds O₂ uptake kinetics during subsequent moderate intensity exercise in healthy young adults. *Journal of Physiology*, 577, pp.985-996.
- Karvonen, J. (1992) Importance of warm up and cool down on exercise performance. In: Karvonen, J., Lemon, P. W. R. and Iliev, I., editors. *Medicine and sports training and coaching*. Basel: Karger, pp.190-213.
- Maglischo, E. (2003) *Swimming Fastest*. Champaign; IL: Human Kinetics.
- McCutcheon, L. J., Geor, R. J., and Hinchcliff, K. W. (1999) Effects of prior exercise on muscle metabolism during sprint exercise in humans. *Journal of Applied Physiology*. 87 (5) pp.1914-22.

Manipulation with intensity load of elite cross-country skiers during the pre-season period

Michal Malák

Faculty of Humanities, Matej Bel University in Banská Bystrica, Slovak Republic

Abstract

The purpose of the present study was to examine relationships between the intensity load of training and performance in the Slovak national cross-country ski team members during the pre-season preparation. Two Slovak male elite cross-country skiers were studied during the spring, summer, and autumn before the winter season using special testing batteries for cross-country skiing. We evaluated the results from the tests batteries, and compared them to each other after each mesocycle. The batteries tests are consisting of three physiological tests: roller skiing sprint freestyle technique test (RS), double pooling on roller skis freestyle technique test (DP), and athletic running uphill test (UR). The tests were undertaken after each four weeks period, together six times. We used as an experimental factor the % change of training intensity in the range of 75 % to 85 % of maximum heart rate (zone R2) from total training load. We did correlation between the results obtained in “controlled” training concept (CC<6 % R2) versus “uncontrolled” training concept (UC>6 % R2). We tried to point out, which intensity training concept positively or negatively affects the performance of two elite cross-country skiers. We examined the results obtained using the mathematical-statistical methods. Evaluation and subsequent analysis of load intensity were compared to time results from the test batteries. The CC was positively related to RS, DP and UR for our first skier. The UC was positively related to RS, DP and UR for our second skier. Based on our findings, we can claim that our results support both intensity training concepts, but with opposite reactions for our elite cross-country skiers. We propose that training concept will bring a positive feedback for our tested skiers with the increase of their athletic performance in the future. Results indicate that applying the both training concepts CC, and UC in elite cross-country skiers may improve their endurance performance, but it strictly depends on individuality of each athlete.

Keywords: *Cross-country skiing, training concept, training process, mesocycle, load intensity, hearth rate, tests, pre-season period, training zone.*

Introduction

The content of the publication is focused on presentation of research notifications and theoretical studies connected with the problems of science of sport. Especially, the topic

of this research is based on elite cross-country skiers. For many years the cross-country skiing had been at the forefront of training methodology, and the cross-country skiers naturally use the heart rate monitor (Besson, Connolly, 2011). Basic assumption for the achievement of the personal goals is the proper training load (Neumann, Pfützner, Hottenrott, 2005). Malák (2008) analyzed the yearly intensity training load of Slovak cross-country national team member. He found the correlation between training intensity time in the range of 75 % to 85 % of maximum heart rate (zone R2) from total training load to performance. He discovered, and determined a faulted point 6 %, which referred amount of time spent in the zone R2 from the total training load. The training time spent over 6 % in the intensity zone R2 from total load will affect performance negatively. The training time spent under 6 % in the intensity zone R2 from total load will affect performance positively. To the forefront came such a training philosophy, where the athlete watches his heart rate with the goal not to exceed the specified intensity zone (Malák, 2013). Honzlová (2007) states that in the cycle from 1988/89 to 1992 Winter Olympics in Albertville there was a year-round collective training of entire national team, which, in a healthy rivalry between members of the team, caused intensification of training process leading to better results. Divald (2009) recommends skipping mentioned range of 75 %-85 % of maximum heart rate during the practice, and only passing through it to the higher intensities. We know that we have a lot of different opinions about intensification of the training. In this case, we would like to focus at whether this new trend is a helping hand for performance improvement, or whether it would be better to return to the past, and focus on athlete's own feelings without the intervention of modern technology.

Methods

Two Slovak male elite cross-country skiers were studied during the spring, summer and autumn before the winter season using the special testing batteries for cross-country skiing. M.K., male, 21 years old, 1.86 m, 83.8+/-1.1 kg., D.B., male 21 years old, 1.85 m, 77.2+/-2.2 kg. We evaluated the results from the tests batteries (time trails), and compared them to each other after each mesocycle. The tests were undertaken after each four weeks period, together six times. The batteries tests are consisting of three physiological tests: roller skiing sprint freestyle technique test (RS), double pooling on roller skis freestyle technique test (DP), and athletic running uphill test (UR). We used as an experimental factor the % change of training intensity in the range of 75 % to 85 % of maximum heart rate (zone R2) of total training load. We did comparison between the results obtained in "controlled" training concept (CC < 6 % R2) versus "uncontrolled" training concept (UC > 6 % R2). Both skiers

absolved totally the same training process, but only the training time in zone R2 was changed during each mesocycle according the table 1.

Tab. 1 Scheme of a sequence and alternating of each training concept

	Test I.	Test II.	Test III.	Test IV.	Test V.	Test VI.
M.K.	Input	CC<6% R2	UC>6% R2	CC<6% R2	UC>6% R2	CC<6% R2
D.B.	Input	UC>6% R2	CC<6% R2	CC<6% R2	UC>6% R2	CC<6% R2

We examined the results obtained with using the mathematical-statistical methods. Evaluation and subsequent analysis of load intensity was compared to time results from the tests batteries (time trails).

Results

We compared each mesocycle training concept to time results (tables 2, 3) from the tests batteries. We did it the same comparison for each tested skier. We used symbols +/- for expressing a positive, or a negative time influence (changes index) during “controlled” training concept (CC < 6 % R2), and “uncontrolled” training concept (UC > 6% R2) in each four weeks cycles.

Tab. 2 Results of the tests during 24 weeks period – M.K.

Discipline	RS		Changes index	DP		Changes index	UR		Changes index
	input	output		input	output		input	output	
CC < 6% R2	3.27	3.16	+11	4.40	4.29	+11	18.34	19.00	-26
UC > 6% R2	3.16	3.26	-10	4.29	4.21	+8	19.00	19.10	-10
CC < 6% R2	3.26	3.22	+4	4.21	4.19	+2	19.10	18.40	+30
UC > 6% R2	3.22	3.25	-3	4.19	4.37	-18	18.40	19.38	-58
CC < 6% R2	3.25	3.19	+6	4.37	4.33	+4	19.38	19.00	+38

Based on our findings, we can say that the “controlled” training concept (CC < 6 % R2) was positively related to RS, DP and UR for our skier M.K. (table 2).

Tab. 3 Results of the tests during 24 weeks period – D.B.

Discipline	RS		Changes index	DP		Changes index	UR		Changes index
	input	output		input	output		input	output	
UC > 6% R2	3.28	3.19	+9	4.29	4.15	+14	18.45	18.51	-6
CC < 6% R2	3.19	3.25	-6	4.15	4.17	-2	18.51	19.40	-49
CC < 6% R2	3.25	3.22	+3	4.17	4.17	0	19.40	19.13	+27
UC > 6% R2	3.22	3.25	-3	4.17	4.18	-1	19.13	19.23	-10
CC < 6% R2	3.25	3.23	+2	4.18	4.13	+5	19.23	19.47	-24

According to table 3 we can state, that the UC concept (UC > 6% R2) was positively related to RS, DP and UR for our skier D.B.

Tab. 4 Test RS summary results D.B. and M.K.

DB - RS	TOTAL %	TOTAL TIME	MK - RS	TOTAL %	TOTAL TIME
CC < 6% R2	-0.58	-1	CC < 6% R2	10.18	21
UC > 6% R2	2.84	6	UC > 6% R2	-6.59	-13

Roller ski sprint Freestyle technique:

In the summary of CC versus UC (table 4), we can claim that D.B.'s time during CC concept overall deteriorated by -1s, what represents a -0.58 % performance degradation. With UC we recorded by D.B.'s 6s improvement, what represents a 2.84 % performance improvement. M.K. improved the overall time by 21 seconds, what represents a 10.18 % performance improvement during the CC. On the other hand, M.K. recorded -13s deterioration, what represents a performance degradation of -6.58 % during the UC training concept.

Tab. 5 Test DP summary results D.B. and M.K.

DB - DP	TOTAL %	TOTAL TIME	MK - DP	TOTAL %	TOTAL TIME
CC < 6% R2	1.15	3	CC < 6% R2	6.14	17
UC > 6% R2	4.82	13	UC > 6% R2	-3.98	-10

Double pooling (freestyle technique equipment):

In the summary of test results (table 5), we can claim that D.B. overall time was improved by 3s, what represents a 1.15 % performance improvement during the CC training. With UC we recorded by D.B.'s 13s improvement, what represents increasing performance of 4.82 %. M.K. improved the overall time by 17s, what represents a 6.14 % performance improvement during the CC. M.K. recorded -10s deterioration, what represents performance degradation of -3.98 % during the UC training concept.

Tab. 6 Test UR summary results D.B. and M.K.

DB - UR	TOTAL %	TOTAL TIME	MK - UR	TOTAL %	TOTAL TIME
CC < 6% R2	-4.11	-46	CC < 6% R2	3.50	42
UC > 6% R2	-1.40	-16	UC > 6% R2	-6.06	-68

Athletic uphill running:

According to table 6, we can claim that D.B.'s time overall deteriorated by -46s during CC concept, what represents a -4.11 % performance degradation. With UC his overall time deteriorated by -16s, what represents performance decrease of -1.40%. M.K.'s overall time improved by 42s, what represents a 3.50 % performance improvement during the CC. M.K. with UC concept recorded -68s deterioration, what represents performance decrease of -6.06 %.

Discussion

We tried to point out, which intensity training concept positively or negatively affects the performance of two elite cross-country skiers'. In our work we focused on the detection and monitoring of the impact of the training intensity load on cross-country skiers performance. We did research in cross-country skiing with four national team members, but during the whole process only two of them passed all tests. We are solving really interesting and important topic, especially for power-endurance athletes. Malák, Nemeč (2012) concluded that the load intensity zone R2 in the range 75 %-85 % of maximum heart rate, used during the training load, most likely affects the performance of an athlete – a cross country skier.

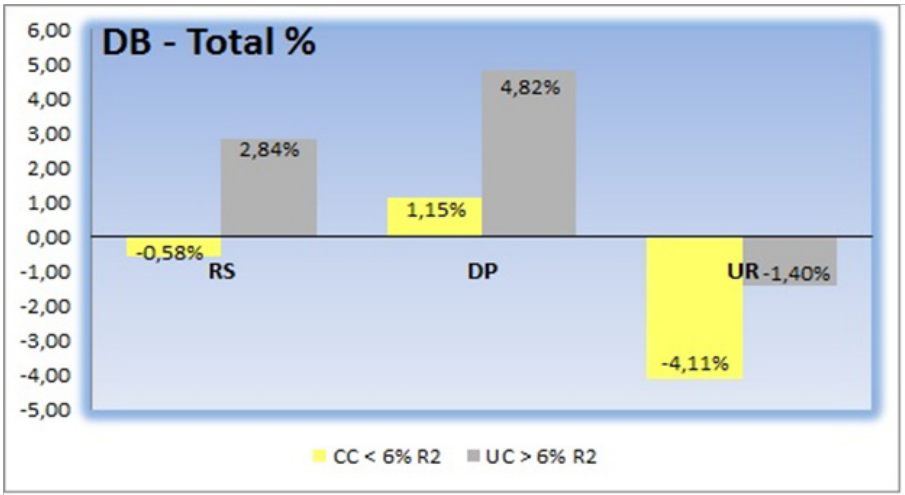


Fig. 1 Percentage change in index of DB

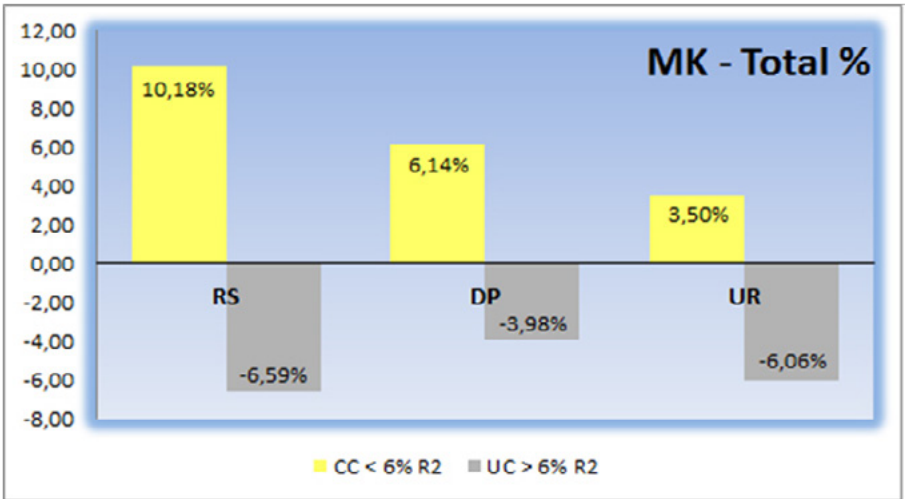


Fig. 2 Percentage change in index of MK

In conclusion for D.B., we can only hardly say that “uncontrolled” training concept (UC > 6 % R2) will be the best solution for his training process in the future (figure 1).

From the % results (figure 2) of M.K. we can say, and recommend that the “controlled” ($CC < 6 \% R2$) training concept will improve his performance during the training process in the future. Usage of individual training concept may improve competitive results in cross-country skiers who fail to respond to previous training.

Conclusions

We found out certain negative aspects while applying “uncontrolled” ($UC > 6 \% R2$) training concept during M.K. pre-season period. We found out certain negative relationships while applying “controlled” ($CC < 6 \% R2$) training concept during DB pre-season period. We found out certain positive aspects while applying “controlled” ($CC < 6 \% R2$) training concept during MK pre-season period. We found out certain positive relationships while applying “uncontrolled” ($UC > 6 \% R2$) training concept during DB pre-season period. Based on our findings, we can claim that our results support both intensity training concepts, but with opposite reactions for our elite cross-country skiers. We confirmed Divald (2009) and Honzlová (2007) findings, too. CC was observed to be most effective in improvements for MK. UC was more effective in producing improvements for D.B. We figured out, which training concept will bring a positive feedback with respect to the increase of the athletic performance of both tested skiers in the future. Results indicate that applying the both training concepts CC, and UC in elite cross-country skiers may improve their endurance performance, but it strictly depends on individuality of each athlete.

References

Benson, R. – Connolly, D. 2011. Heart Rate Training. Human Kinetics: Champaign IL, 2011. 184 s. ISBN 978-80-247-4036-2.

Dívald, L. 2009. Kontrolovaný tréning. Poprad: Slza, 2009. 116 s.

Honzlová, Z. 2007. Růst sportovní výkonnosti v závislosti na tréninkových prostředcích v běhu na lyžích. diplomová práce: Brno: MU, FSpS, 2007. 59 s.

Malák, M. 2008. Analýza obsahu ročného tréningového cyklu 2006/2007 reprezentanta Slovenska v behu na lyžiach: rigorózna práca. Banská Bystrica: FHV UMB, 2008. 111 s.

Malák, M. – Nemeč, M. 2012. Kondičný tréning v roku 2012. Analýza intenzity zaťaženia v pretekovom období u reprezentanta Slovenska v behu na lyžiach. Banská Bystrica: FHV UMB, SAKT, 2012. s. 264-275. ISBN 978-80-8141-023-9.

Neumann, G. – Pfützner, A. – Hottenrott, K. 2005. Trénink pod kontrolou. Grada Publishing, 2005. 184 s. ISBN 80-247-0947-3.

Effects of physical load on the dependence between postural stability and shooting performance in biathlon

Michal Mojžiš, Božena Paugschová

Faculty of Humanities, Matej Bel University in Banská Bystrica, Slovak Republic

Abstract

The purpose of the study was to determine the effects of physical load on postural stability and shooting performance of biathletes. The studied group consisted of two youth women and one youth man aged 15-19 years. Postural stability was diagnosed by the device FiTRO Sway check and shooting performance was measured by the laser system SCATT Professional in laboratory conditions. We performed 16 measurements at rest and 16 measurements after load during four days. In test Tcalm we monitored shooting at rest, in Tload we tested shooting after load. The intensity of the load on the running ergometer was determined by individual anaerobic threshold (RQ method). Positive or negative dependence of shooting performance and postural stability was assessed by Spearman's correlation coefficient (ρ). We determined that the dependence of shooting performance and postural stability in biathlon shooting was different in each biathlete. Proband B1 has reached low negative dependence Tcalm ($\rho = -0.22$), and low negative dependence after load Tload ($\rho = -0.25$). In proband B2 we found high negative dependence Tcalm ($\rho = -0.69$) between shooting performance and postural stability ($p < 0.01$). After physical load, B2 reached medium positive dependence ($\rho = +0.45$). Proband B3 exhibited low positive dependence Tcalm ($\rho = +0.23$) and medium negative dependence Tload ($\rho = -0.46$). Under the influence of the load on postural stability, the proband B1 exhibited decrease in stability of -12.6 %, B2 decrease of -16.2 %, and B3 decrease of -56.8 %. We also observed, in all subjects, negative impact of physical load on the shooting performance (B1 = -0.2 %, B2 = -1.4 %, B3 = -5.4 %). In the presented study we confirmed the negative impact of physical load on shooting performance (performance decrease from -0.2% to -5.4%) and on postural stability (stability decrease from -12.6 % to -56.8 %), compared to those of shooting in rest, by all probands. The correlation was different in each biathlete, which implies the relationship between postural stability and shooting performance is (at junior age) individualistic. As a result of the small number of probands, it is not possible to draw general conclusions.

Keywords: Biathlon, physical load, postural stability, shooting performance.

Introduction

Balance ability in standing shooting position is, according to Ondráček (2011), primarily static. As a matter of fact, it is genetically determined and by training and exercise it can only be improved partially. In a standing shooting position, one's aim is slightly more labile due to smaller support area, high center of gravity above the support area, and weight of rifle (Paugšchová, 2000). As the most reliable parameter for the assessment of postural stability it has proven to be speed of gravity (Zemková & Hamar, 2002). The stability of shooting position, according to Larue et al. (1989), is directly related to postural stability, which also Simoneau et al. (1997), Gros Lambert et al. (2003), Mononen et al. (2006), Sattlecker, Müller & Lindinger (2007), Straňák (2007), Laaksonen, Ainegren & Lisspers (2011), Čech (2011) and others agree with. The authors characterize biathlon shooting as a complex of physical activities, requiring good postural stability with rapid execution of movement. The load intensity in biathlon shooting, based on the studies of Hoffman et al. (1990), in a standing shooting position immediately after the load, significantly ($p < 0.01$) effects the shooting results and the stability of holding a rifle. Mononen et al. (2006) substantiate the importance of stabilizing the movement of the rifle, especially during the aiming phase, and they consider postural stability as a limiting factor when shooting in standing position, which also authors: Larue et al. (1989), Sattlecker, Müller & Lindinger (2007), Straňák (2007) and Ondráček (2011), who deal with biathlon shooting, agree with.

Straňák (2007) investigated at the test group of biathletes ($n = 9$, aged 16-19 years) the impact of the previous load on postural stability in shooting at standing shooting position. In the thesis conclusion, he states that there is a relationship between postural stability and successful shooting. At higher stability, shooting was more successful, and vice versa.

After evaluating all subjects, the author concluded that stability is one of the key success factors in biathlon shooting. The results of experiments (Seljunin & Fomin, 1988; Hoffman et al., 1990, 1992; Gros Lambert et al., 1998 Paugšchová, 2000 Lakie, 2009) agree on the negative impact of load on the shooting performance. Based on the research of Hoffman et al. (1990, 1992), Grebot & Burtheret (2007), and Straňák (2007) it was determined that during shooting in standing position due to the previous load, postural stability is significantly reduced and the shooting time is prolonged. Era et al. (1996), Mononen et al. (2006), and Čech (2011) who demonstrated the impact of sport rifle shooting on postural stability, agreed with the given findings. By lowering the level of stability, shooting score plummeted. The given studies, however, do not specify how was the correlation between postural stability in relation to shooting performance proven. Therefore, we tried to investigate whether this dependence is

positive or negative. A research of Petrovič (2004) did not confirm the hypothesis based on the successful shooting level of individual physical loads in cross sections just before the shooting.

The aim of the study was to determine the influence of physical load on correlation relationship between postural stability and shooting performance in biathletes.

Study is part of VEGA MŠVVaŠ SR no. 1/0757/12 Reactive and adaptive indicators of physical and mental performance changes in sportsman following the biorhythms of different lengths period.

Methods

Description of the examined group

The examined group consisted of two female biathletes (B1, B2) and one male biathlete (B3) of the biathlon club ŽP Šport, a. s. Podbrezová (Tab. 1). Spiroergometry was realized on 13th of June 2013. RQ (respiration quotient) method was used for setting individual anaerobic threshold ($\dot{V}iANT$).

Tab. 1 Examined group (06/13/2013)

Biathlete	Age (years)	Sex	Height (cm)	Weight (kg)	$\dot{V}iANT$ (HR.min ⁻¹)	HR _{max} (HR.min ⁻¹)	v_{COP} in rest (mm.s ⁻¹)
B1	15.1	F	170	58	183	205	17.5
B2	15.8	F	171	63	172	196	17.7
B3	18.9	M	183	73	169	186	19.2

Legend:

HR_{max} (HR.min⁻¹) – maximal heart rate in 1 minute

$\dot{V}iANT$ (HR.min⁻¹) – heart rate in 1 minute of anaerobic threshold level

v_{COP} in rest (mm.s⁻¹) – Centrum-Of-Pressure velocity in rest conditions (mm/s)

Measurements arrangement

The diagnosis was conducted at the premises of the Private gymnasium of Železiarne Podbrezová in laboratory conditions. It was carried out in terms from 30th of June 2013 to 03th of July 2013 (preparatory period I.) in days: Sunday, Monday, Tuesday, and Wednesday. Research testing was carried out twice a day. Tests were conducted in the morning from 9:00AM to 10:45AM and in the afternoon between 3:00 PM and 4:45 PM. Overall, we performed 16 measurements at rest and 16 measurements after load in four days in the standing shooting position.

The methods used

By test Tcalm (5 round clips) we monitored shooting performance and postural stability at rest. This test was conducted 2 times right after. By test Tload (5 round clips) we investigated the level of performance after load in the intensity of the individual anaerobic threshold (\dot{V}_{O2NT}) on running on a treadmill. This test was conducted 2 times right after. Biathletes performed zeroing on stabilometric plateau and then warm up identical to the preparation for a race. Those tests were performed immediately after each other without rest. To evaluate the position and movement of the muzzle, we used laser device SCATT Professional (Scatt, Russian Federation, version 6.021), which was attached to the end of the muzzle on the right hand side. Due to the accurate measurement of interventions we used discipline 10 m Air Rifle, where we investigated the performance on 5 shots with the maximum score of 54.5 (one shot = 0 to 10.9 points). Distance in laboratory conditions has been reduced from 50 m to 5 m from the target to the muzzle. All biathletes performed dry shooting with their own rifle – type Anschütz Fortner 1827 (Anschütz, Germany) in the race-like shooting rhythm.

For the assessment of postural stability, when shooting while standing, we used stabilometric examination. Shooting took place on stabilometric plateau FiTRO Sway Check (FiTRONIC, Slovak Republic). Data from the platform were recorded by the program FiTRO SwayP, which records dynamic position changes of the COP (Center-Of-Pressure) in the Cartesian coordinate system (X, Y). The level of postural stability was analyzed by the average speed of movement of COP (mm.s⁻¹). The recording period lasted 40 seconds. Start of the diagnostic devices was dependent upon: when the biathlete was ready to shoot, the time when he/she got into the shooting position and started aiming at the target. If the biathlete completed shooting earlier, he/she was instructed to remain in a static shooting position to the end of the recording. Using test \sqrt{COP} we investigated the level of the static shooting position without dry shooting (mm.s⁻¹), just standing with a rifle. Heart rate was monitored by Polar 400RS (Polar, Finland) with a recording interval of 5 seconds.

For the quantitative evaluation of the data, we used basic descriptive characteristics of the performance values – arithmetic mean (\bar{x}) and standard deviation (SD). The statistical analysis was conducted by using the IBM SPSS Statistics 19 software. We determined the relationship between shooting performance and postural stability by Pearson correlation coefficient (ρ) at the 1 % level of α ($p < 0,01$). Correlation (in absolute value) below 0.1 = trivial; 0.1-0.3 = low; medium = 0.3-0.5 and over 0.5 = high. Negative dependence = achieved number of points in the shooting performance with lower (-) speed of the COP. Positive dependence = achieved number of points in the shooting performance with higher (+) speed of the COP.

Results

Proband B1 reached shooting performance in the T_{calm} test by 22.5 ± 5.0 points. The level of proband's stability during the standing shooting position was 17.3 ± 1.6 mm.s⁻¹ (v_{COP} in rest = 17.5 mm.s⁻¹). Dependence of shooting performance and postural stability was observed at $\rho = -0.22$, which is a low negative dependence (for number of points achieved in the shooting performance, it was observed the lower speed of the COP = higher level of stability). B1 in the shooting T_{load} test achieved 22.4 ± 7.2 points, which is compared to the rest conditions the minimum difference (-0.2%). Postural stability after load on the treadmill run decreased to the level of 23.6 ± 6.9 mm.s⁻¹ (stability decrease of -12.6%). Dependence of shooting performance and postural stability after physical load was recorded at $\rho = -0.25$, therefore also low negative dependence (for number of points achieved in the shooting performance, it was lower speed of the COP = higher level of stability).

Tab. 2 Correlation dependence of shooting performance and postural stability of biathletes

TEST/Biathlete		B1	ρ	B2	ρ	B3	ρ
T_{calm}	Shooting (points \pm SD)	22.5 ± 5.0	-0.22	33.3 ± 4.3	-0.69**	29.3 ± 5.0	+0.23
	Stability (mm.s ⁻¹ \pm SD)	17.3 ± 1.6		20.2 ± 4.0		18.6 ± 2.4	
T_{load}	Shooting (points \pm SD)	22.4 ± 7.2	-0.25	32.6 ± 5.0	+0.45	26.6 ± 6.3	-0.46
	Stability (mm.s ⁻¹ \pm SD)	23.6 ± 6.9		28.3 ± 3.5		47.0 ± 8.9	

Legend:

T_{calm} – test performed in rest conditions

T_{load} – test performed after the load at i^{ANT}

SD – Standard Deviation

** – $p < 0,01$

Proband B2 reached shooting performance in test T_{calm} 33.3 ± 4.3 points. The level of biathlete's stability during the shooting standing shooting position was 20.2 ± 4.0 mm.s⁻¹ (v_{COP} rest in = 17.7 mm.s⁻¹). The dependence of shooting performance and postural stability was observed at $\rho = -0.69$, representing a high negative dependence, statistically significant ($p < 0.01$). At the given number of points attained when shooting, the proband achieved lower speed of the COP = higher level of stability. B2 reached

32.6 ± 5.0 points in shooting performance T_{load} test, which is compared to the rest conditions slight decrease of -1.4%. Postural stability after load on treadmill run decreased to the level of 28.3 ± 3.5 mm.s⁻¹ (decrease stability of -16.2%). Dependence of shooting performance and postural stability after physical load was observed at $\rho = +0.45$; medium positive dependence. Number of points achieved in the shooting performance, it was observed higher speed of the COP = lower stability level.

B3 reached a shooting performance in the test T_{calm} 29.3 ± 5.0 points. The level of stability of the biathlete during the standing shooting position was 18.6 ± 2.4 mm.s⁻¹ (\sqrt{COP} in rest = 19.2 mm.s⁻¹). Dependence of shooting performance and postural stability was observed at $\rho = +0.23$, which is a low negative dependence. Number of points achieved in shooting performance, it was observed higher speed of the COP = lower level of stability. B3 in the shooting test T_{load} reached 26.6 ± 6.3 points, which is compared to the rest conditions difference -5.4%. Postural stability after load on treadmill run decreased to the level of 47.0 ± 8.9 mm.s⁻¹ (decrease stability up to -56.8%). The dependence of shooting performance and postural stability after physical load was observed at $\rho = -0.46$, thus moderate negative dependence. Number of points achieved in the shooting performance, it was observed lower speed of the COP = higher level of stability.

Weak points of the research were small number of biathletes and we should have used more stabilometric parameters (X, Y axis, path length) for evaluation.

Discussion

Hoffman et al. (1990) investigated the effect of the intensity load on shooting performance of American professional biathletes (n = 13) at rest, after exercise of 130 HR.min⁻¹, 150- HR.min⁻¹, 170 HR.min⁻¹ and to the individual maxima in both shooting positions (2x5 shots). Diagnostics were realized after bicycle ergometer load. Repeated measurements using ANOVA revealed that in standing shooting position intensities of 170 HR.min⁻¹ and maximum individual there were significant differences ($p < 0.01$) compared with low load intensities. In our research, we confirmed the negative impact of load in shooting performance as well as in postural stability of all biathletes.

Larue et al. (1989) investigated the relationship between the biathlon shooting and shooting at sports shooters. They found significant correlation between shooting at rest and after exercise. Based on the analysis of the impact of physical load on the biathlon shooting precision by Paugschová (2000), author notes that poorer physical fitness results in a weaker shooting performance. A negative sign is also degression of overall endurance in the categories of pupils and youth for the period of 2001-2011 (Mojžiš, 2011).

Sattlecker, Lindinger & Müller (2007) argue that professional biathletes have their own ways of shooting, which are stable. On the other hand, faulty movement patterns are difficult to clear.

Sattlecker, Müller & Lindinger (2009) compared youth and elite biathletes. The elite group showed higher shooting score and the youth group had higher deviation in stance stability. Results showed significant differences between groups.

Vonheim (2012) investigated the shooting performance of biathletes at different load intensities (75-80 %, 85-87 % and 90-95 % of maximum HR) on roller skis on a ski treadmill in the lab. Thirteen youth attended three different tests (4x6 min) and warm ups before the shooting took place, just after the warm up and after each load change. During the shooting biathletes were on the stabilometric plate, which measured the movements of the center of pressure (the COP) in the direction of anterior-posterior and medio-lateral. To record movement of muzzle they used accelerometer. Results showed a non-significant ($p > 0.05$) effect of load intensity on shooting performance, but author found a significant difference ($p < 0.05$) in rifle hold (static position) and the trajectory tracking (dynamic movement). COP movement was higher in the anterior-posterior direction ($r = 0.759$), which was also observed by Straňák (2007) and Čech (2011). Čech (2011) monitored at sport shooters fluctuations of targeting point (shooting simulator SCATT Professional) and correlated it with postural stability (stabiometric plateau FiTRONIC Sway Check) 5 to 1.5 s before shot. He found moderate to high positive dependence ($p < 0.01$) for individual endpoints for sport rifle shooters in standing shooting position.

Conclusion

In the presented study we confirmed the negative impact of physical load on shooting performance (performance decreased from -0.2% to -5.4 %) and on postural stability (stability decreased from -12.6 % to -56.8 %) compared with those of rest shooting by all subjects. The correlation was different for each proband. This implies that the relationship between postural stability and shooting performance is (at junior age) individual. Proband B1 reached in both tests negative correlation dependence. Number of points achieved in the shooting performance, it was observed lower speed of the COP = higher stability level. B2 in the test T_{calm} reached a high negative dependence, but after the load, moderate positive correlation was observed. That means, at the given number of points achieved in the shooting performance, higher speed of COP = lower stability level, was observed. Proband B3 reached low positive dependence in T_{calm} , on the other hand, the proband, in T_{load} , achieved medium negative dependence. Because of the low number of probands, it is not possible to draw general conclusions.

References

- Čech, P. 2011. Vzťah posturálnej stability a fluktuácie zameriavacieho bodu strelcov. In *Scientia Movens*. Praha: UK FTVS, 2011. ISBN 978-80-86317-84-7. p. 28-32.
- Era, P., Kontinen, N., Mehto, P., Saarela, P., Lyytinen, H. 1996. Postural stability and skilled performance – a study on top-level and naive rifle shooters. In *Jurnal of biomechanics*, 1996, vol. 29, no. 3, p. 301-306.
- Grebot, C. & Burtheret, A. 2007. Effects of Temperature Changes on the Mechanical and Ballistic Responses in Biathlon Shooting. In *J. Appl. Mech.* ISSN 1528-9036, 2007, vol. 74, no. 5, p. 137-141.
- Gros Lambert, A., Candau, R., Grappe, F., Dugué, B. & Rouillon, J. D. 2003. Effects of Autogenic and Imagery Training of the Shooting Performance in Biathlon. In *Research Quarterly for Exercise and Sport*. ISSN 0270-1367, 2003, vol. 74, no. 3, p. 337-341.
- Gros Lambert, A., Grappe, F., Candau, R. & Rouillon, J. D. 1998. Cardio-ventilatory responses in biathlon standing shooting. In *Science & Sports*. ISSN 0765-1597, 1998, vol. 13, no. 3, p. 135-137.
- Hoffman, M. D. & Street, G. M. 1992. Characterization of the Heart Rate Response during Biathlon. In *Int J Sports Med*. ISSN 0172-4622 1992, vol. 13, no. 5, p. 390-394.
- Hoffman, M. D., Gilson, P. M., Wetenburg, T. M. & Spencer, W. A. 1992. Biathlon Shooting Performance after Exercise of Different Intensities. In *Int J Sports Med*, 1992, no. 13, p. 270-273.
- Laaksonen, M. S., Ainegren, M. & Lisspers, J. 2011. Evidence of improved shooting precision in biathlon after 10 weeks of combined relaxation and specific shooting training. In *Cognitive behaviour therapy*. ISSN 1650-6073, 2011, vol. 40, no. 4, p. 237-250.
- Lakie, M. 2009. The influence of muscle tremor on shooting performance. In *Exp Physiol*. ISSN 1469-445X, 2009, vol. 95, no. 3, p. 441-450.
- Larue, J., Bard, C., Otis, L. & Fleury, M. 1989. Stability in shooting: the effect of expertise in the biathlon and in rifle shooting. In *Canadian Journal of Sport Science*, 1989, vol. 14, no. 1, p. 38-45.

Mojžiš, M. 2011. Analysis of multi-annual endurance abilities level of young biathletes in decade 2001 – 2011. In *Acta Universitas Matthiae Belii*, Physical education and sport. ISSN 1338-0974, 2011, vol. 3, no. 2. p. 60-67.

Mononen, K., Kontinen, N., Viitsalo, J. & era, P. 2006. Relationships between postural balance, rifle stability and shooting accuracy among novice rifle shooters. In *Scandiavian Journal of Medicine and Science in Sport*. ISSN 1600-0838, 2006, vol. 17, no. 2, p. 180-185.

Ondráček, J. 2011. Charakteristika psychomotorických a technických podmínek úspěšné střelby v biatlonu [Habilitation work]. Brno: MU FSS, 2011. 158 p.

Paugšchová, B. 2000. Teória a metodika športového tréningu v biatlone. Banská Bystrica: FHV UMB, 2000. 160 p. ISBN 80-8055-383-1.

Petrovič, P. 2004. Niektoré faktory ovplyvňujúce presnosť streľby v biatlone. In *Nové trendy univerzitného športu po vstupe do európskej únie*. Bratislava: PEEM, 2004. ISBN 80-89197-08-6, p. 44-48.

Sattlecker, G., Müller, E. & Lindinger, S. 2007. Performance determining factors in biathlon shooting. In *Science and nordic skiing, 2007*. Vuokati: Meyer & Meyer sport. ISBN 978-1-84126-229-1. 304 p.

Sattlecker, G., Lindinger, S. & Müller, E. 2009. Biomechanical factors of biathlon shooting in elite and youth athletes. In *Science and Skiing IV, 2009*. Maidenhead: Mayer & Mayer Sport. ISBN 978-1-84126-255-0. p 641-646.

Seljunin, E. A. & Fomin, S. K. 1988. Improvement of results, expectancy and shooting stability of the biathlonists. In *Teor i prak fiz kul't.*, 1988, no. 1, p. 28-29.

Simoneau, M., Bard, C., Fleury, N., Teasdale, N. & Boulay, M. 1997. The effects of metabolic activation on postural stability and shooting performance in elite and intermediate biathletes. In *Science et Motricité*, 1997. no. 29, p. 22-29.

Straňák, P. Posouzení stability u vybraných sportovců v biatlonu [Diplomová práce]. Brno: FSpS MU, 2007. 167 p.

Vonheim, A. 2012. The effect of skiing intensity on shooting performance in biathlon [Diplomová práca]. Trondheim: NTNU, 2012. 34 p.

Zemková, E. & Hamar, D. 2002. Spoľahlivosť stabilografických parametrov na dynamometrickej platni. In Telesná výchova & šport, 2002, vol. 12, no. 2, p. 28-30.

The comparison of game performance in beach volleyball at the 2012 Olympic Games in the final men and women matches in the selected game activities

Marián Uvaček

Faculty of Mechanical engineering, Slovak University of Technology, Bratislava, Slovak Republic

Abstract

The author of the article deals with comparison of game performance in beach volleyball at the 2012 Olympics in London.

He reviewed two game activities of pass and receiving pass in the final men and women matches and tried to compare the difference in these game activities.

Keywords: *beach volleyball, individual game activities, playing performance, evaluation of game performance.*

Introduction

The sports performance is comprehensively characterized by the level of produced sport activities (readiness to bring performance), which are the demonstration of the perfectly adopted motion skills. It is the result of a summary of the changes caused by the cumulative training effect in the field of motive power, psychical and biological components and security functional mechanisms that form the current performance capacity of the athlete's organism (Dovalil et al., 1992, 2002). The effort to judge and evaluate the game performance in volleyball can be seen relatively often. The methods used are significantly disputable and almost all already known bring some advantages, but also some shortcomings. The problems of evaluation of game performance in volleyball elaborated especially: Ejem (1970,1972,1973,1976); Eom-Schutz (1992); Horák (1997); Zapletalová-Přidal (1995); Přidal (2001) and other.

Volleyball is generally characterized as an integrated game activity, which consists of six game activities of an individual – pass, receiving of pass, recording, attack, block and defence on the field. Activities follow each other in a hierarchical order. The game performance in beach volleyball is unique, and is determined, particularly, by the nonstandard conditions such as deep sand, unstable field surface, substituting and large variability of game situation, large number of kick-ins during the game, which demand extraordinary cooperation.

The goal was to gain knowledge of the frequencies of the individual game activities in order to determine the implementation quality of the individual game activities and to compare game activities in two final matches.

The task was to determine and compare the frequency of occurrence and quality of game activities conducted by an individual, success and failure of teams in the selected sets.

Methods

The examined group consisted of 4 Olympic teams that succeeded to play in the finals in the beach volleyball. Women’s final was played by American players, the first couple consisted of experienced women players Kerri Walsh – Misty May Treanor (USA1) who defeated their compatriots Jennyfer Kessy – April Ross (USA2) 2:0. The male final was played by an experienced couple from Brazil Emmanuel Rego –Alison Ceruti who lost against quite younger couple from Germany Julius Brink – Jonas Reckermann 1:2.

The variables examined were collected into prepared data collection sheets. When processing and evaluating collected data the logical and mathematical-statistical methods (absolute and relative frequency occurrence, chi-square test) were used.

Results and Discussion

The table 1 introduces the frequency of variables difference observed in both matches. When comparing the teams we observed a major difference in the number of submission in the women’s final match and in men’s game. (11 passes in favour of winners)

Tab. 1 Introduces absolute and relative number of individual game activities, pass and receiving pass

Selected teams	Pass	Receiving pass
USA 1	42	27
USA 2	31	37
Total	73	64
GER	55	45
BRA	52	53
Total	107	98
Total score	180	162

In the table 2 and 3 the dependence of the winning passes on their quality observed in both final matches is introduced.

Tab. 2 Presents the dependence of the winning female teams on the quality of their passes USA1 – USA2

Pass	1	2	3	4	5	Total
Winners	2	0	11	24	5	42
	2.30137	0	13.23288	21.28767	5.178082	
The losers	2	0	12	13	4	31
	1.69863	0	9.767123	15.71233	3.821918	
	4	0	23	37	9	73

While observing women’s match we have not found out any statistically significant ratio $\chi^2=1,80$; $p<0.05$ between success of the team in the game and quality of its passes.

Tab. 3 Presents the dependence of the winning male teams on the quality of their passes GER-BRA

Pass	1	2	3	4	5	Total
Winners	1	6	10	36	2	55
	1.542056	3.598131	8.224299	37.00935	4.626168	
The losers	2	1	6	36	7	52
	1.457944	3.401869	7.775701	34.99065	4.373832	
	3	7	16	72	9	107

No statistically significant ratio $\chi^2=7,60$; $p<0.05$ was found out between the success of the team in the game/set and the quality of its passes in the match observed.

When comparing the quality of pass performed during the both observed men’s and women’s matches, we have not found any statistical significance. Furthermore, the examination was focused on the variability of the pass which varied more in men’s than in women’s matches. Men refrained from risky jumping smashed pass and used more or less effectively bringing jumped and jumped soaring pass without starting from the baseline. The blocker used a pass 3 m from the baseline and at maximum

business he used a pass of the baseline from the ground. Women used more or less soaring pass from the baseline or soaring pass from starting up except for April Ross, who served the jumping smashed pass.

In the table 4 and 5 sets dependence of winning receiving passes in both final observed matches.

Tab. 4 Dependence of the team’s success on the quality of pass receiving USA1 – USA2

Income	1	2	3	4	5	Total
Winners	13	0	10	2	2	27
	15.60938	0	8.015625	1.6875	1.6875	
The losers	24	0	9	2	2	37
	21.39063	0	10.98438	2.3125	2.3125	
	37	0	19	4	4	64

In the observed match we identified statistically unknown ratio $\chi^2=1,80$; $p<0.05$ between the team’s success in the set/game and the quality of its pass receiving.

Tab. 5 Dependence of the team’s success on the quality of the pass receiving GER – BRA

Income	1	2	3	4	5	TOTAL
Winners	36	0	6	1	2	45
	33.06122	0	7.346939	3.214286	1.377551	
The losers	36	0	10	6	1	53
	38.93878	0	8.653061	3.785714	1.622449	
	72	0	16	7	3	98

The statistically non-significant ratio $\chi^2=4,77$; $p<0.05$ was identified between the team’s success in the set/game and quality of its pass receiving during the examined matches.

The comparison of the quality of the receiving pass must be based on the quality of the pass already mentioned. There is significant difference by comparison of quality of receiving the pass performed by men and women which can be expressed by percentages:

Women – the quality of receiving the pass by which they could attack more qualitatively and attack performed with less quality – the difference was 58 % : 42 %. By men the difference was 73 % : 27 % in favour of the pass receiving quality.

Conclusion

In the examined matches we did not find statistically significant differences in the implementation quality between the pass and the receiving pass of the winning and losing teams.

When comparing the individual types of pass the greater variability and harder types of pass were found in men's teams, which were able to alternate different ripples, and thus were able to win. When changing the quality of the ball, logically, the variety and diversity of pass as well as the quality of the limb stroke to the ball had to change respectively. The comparison of the receiving pass by men can be based on improved dynamic movement down the field and of the body structure (height), and by women it can be based on more or less abandoning of risky smashed pass.

The author evaluated the contribution value of the individual game activities in the beach volleyball. The author points to the relationship of winning the game by the team depending on the quality of its game performance during the match. Variables were chosen from the individual game activities in beach volleyball.

References

Dovalil, J. a i.: Výkon a trénig v sportu. Praha: Olympia, 2002.

Dovalil, J. a i.: Sportovný trénig – Lexikón základných pojmu. Praha: UK, 1992.

Horák, J.: Analýza volejbalovej ligy 1975 na základe sledovania úspešnosti herných činností jednotlivca. In: K herným činnostem jednotlivca v odbijené. Praha, UV ČSTV 1976, s. 85-146.

Zapletalová, L. – Přidal, V.: Vplyv kvality herných činností jednotlivca na úspešnosti družstva vo volejbale. In: Acta Fac. Edne.Phls. Comeniane, XXXVII, 1995, s. 115-121.

Přidal, V.: Závislosť úspešnosti družstva od kvantitatívnych a kvalitatívnych charakteristik herných činností jednotlivca vo volejbale. In: Acta Educ. Phys. Com, XLII. Bratislava: UK, 2001, s. 5-54.

Heart Rate Response to Game Load of Female Basketball Players in Category U19 and Senior Category

Tomáš Vencúřík, Jiří Nykodým

Faculty of Sport Studies, Masaryk University, Brno, Czech Republic

Abstract

The aim of this study is to compare the internal response of organism (heart rate) to specific game load of female basketball players in category U19 (1st division) and senior category (2nd division). Eight female basketball players in category U19 (average 17.4±0.99 years old, body height 181±5.95 cm, body weight 63.6±5.76 kg) and nine female basketball players in senior category (average 20.6±2.94 years old, body height 178.4±5.5 cm, body weight 64.9±5.84 kg) participated in our study. The figures of maximum heart rate (HR_{max}) in endurance shuttle run test were used to determine five zones of intensity of physical activity. 1st zone (very light intensity) <50 % of HR_{max} , 2nd zone (light intensity) 50-63 % of HR_{max} , 3rd zone (moderate intensity) 64-76 % of HR_{max} , 4th zone (hard intensity) 77-93 % of HR_{max} , 5th zone (very hard intensity) 94-100 % of HR_{max} . During the game the heart rate and its development was monitored by the telemetric device Suunto Team Pack. When the intensity of specific game load between U19 and senior female basketball players, in individual intensity zones as well as in % of HR_{max} was compared no statistically significant difference was recorded ($p>0.05$). The players in category U19 were active in 1st, 2nd, 3rd, 4th and 5th zone of intensity 0.03 %, 1.31 %, 10.31 %, 66.81 %, 21.55 % of the total time, respectively. The players in senior category were active in 1st, 2nd, 3rd, 4th and 5th zone of intensity 0.02 %, 1.45 %, 7.03 %, 69.06 %, 22.42 % of the total time, respectively. The average figure of the heart rate during the game reached 87.53 % of HR_{max} in category U19 and 87.9 % of HR_{max} in senior category. The results indicate high and almost identical physiological demands on monitored female basketball players during the game in both categories. Therefore, the transition, from the physiological (conditioning) point of view while excluding all other factors, from one category (the U19 1st division) to the other (the senior 2nd division) should be without complications. However, we assume that one should expect higher physiological (conditioning) demands in the senior category of the 1st division.

Keywords: basketball, heart rate, game load, intensity of physical activity.

Introduction

Basketball is one of the most popular sport games in the world which include specific morphological, physiological, psychological and social characteristics. Knowledge of physiological demands placed on basketball players during a game is necessary to define appropriate physical training program. An increase of sport performance is a systematic long-term process in which the individual components of load must be taken into consideration. The internal response of the organism is usually assessed based on the heart rate (HR). HR is one of easily available indicators of the intensity of load. During the game the HR and its development is monitored by the telemetric devices (Schönfelder et al., 2011).

Authors of several research studies (McInnes et al., 1995; Vaquera et al., 2008; Narazaki et al., 2009; Abdelkrim et al., 2010; Montgomery et al., 2010; Vala & Litschmannová, 2012;) have attempted to analyze physiological demands of the basketball game based on internal (the measurements of HR and blood lactate) or external parameters (time-motion analysis). McInnes et al. (1995) specified the data about the physiological requirements imposed on players during competitive games. They found out that the intensity of game load is relatively high, up to 75 % of playing time the players had the HR above 85 % of their the individually diagnosed maximum heart rate (HR_{max}). Rodriguez-Alonso et al. (2003) state average HR of female senior basketball players at 90.8 % from HR_{max} for national level and at 94.6 % from HR_{max} for international level. Abdelkrim et al. (2007) noticed similar values (figures) of average HR (91 % from HR_{max}) of elite junior basketball players. The one of the key issues in basketball is the relation between the game load and the training load. However, Balčiūnas et al. (2006) in their research state that exercises during the training process carried out intermittently (discontinuously) at the high intensity have a significant impact on the training of young players and are in accordance with the requirements (intensity of load) interposed during competitive games. Therefore, the analysis of game intensity is very important for training process.

The aim of this study is to compare the internal response of organism (heart rate) to specific game load of female basketball players in category U19 (1st division) and senior category (2nd division).

Methods

Eight female basketball players in category U19 (1st division) (average 17.4 ± 0.99 years old, body height 181 ± 5.95 cm, body weight 63.6 ± 5.76 kg) and nine female basketball players in senior category (2nd division) (average 20.6 ± 2.94 years old, body height 178.4 ± 5.5 cm, body weight 64.9 ± 5.84 kg) participated in our study.

To obtain the data the measurement of HR, as the body's internal responses to the physical activity, was used. The HR was monitored by telemetric device Suunto Team Pack (Suunto Oy, Vantaa, Finland). Suunto memory belts were set to record HR in twosecond intervals. Telemetric device was synchronized with starting time of the game and camcorder Canon HG10 (Canon Inc., Tokyo, Japan). The HR was assessed from the total time that the subject was on the court, including all interruptions in play (time-outs, free throws, etc.), but excluding breaks between quarters and time spent on bench.

To evaluate the obtained data the software program Suunto Training Manager was used. The figures of maximum heart rate (HR_{max}) in endurance shuttle run test were used to determine five zones of physical activity intensity (Thompson at al., 2010) (table 1). The data are expressed as mean \pm standard of deviation (SD). After normality inspection of data (Shapiro-Wilks test) comparison between U19 and senior players (in each zone) was performed using a non-parametric Mann-Whitney U-test. The statistical package Statistica 10 (StatSoft Inc., Tulsa, USA) was used for statistical calculations. Statistical significance was set to $\alpha=0.05$.

Tab. 1 Classification of physical activity intensity (Thompson at al., 2010)

Zone	HR_{max} (%)	Intensity
1	<50	very light intensity
2	50-63	light intensity
3	64-76	moderate intensity
4	77-93	hard intensity
5	≥ 94	very hard intensity

Results and Discussion

The aim of this study was to compare the internal response of organism (heart rate) to specific game load of female basketball players in category U19 (1st division) and senior category (2nd division). At the end of the endurance shuttle run test we obtained more specific HR_{max} figures when using general equation ($HR_{max} = 220 - \text{age}$) (Robergs & Landwehr; 2002). The figures of HR_{max} in endurance shuttle run test were used to determine five zones of physical activity intensity. The mean HR_{max} of subjects was 196 ± 7.67 beats.min-1 in category U19 and 194.4 ± 4.8 beats.min-1 in senior category. Heart rate results showed that the female players U19 spent in the 1st, 2nd and 3rd zone 0.03 ± 0.14 , 1.31 ± 2.41 and 10.31 ± 15.96 % of the total time, respectively. In the 4th and 5th zone the players spent 66.81 ± 21.86 and 21.55 ± 19.62 % of total time, where the intensity is hard or very hard. The mean HR during the game in U19 category was

87.5 ± 2.8 % of HR_{max} of the total time. The female senior players' game activity in the 1st, 2nd and 3rd zone was 0.02 ± 0.12, 1.45 ± 2.25 and 7.03 ± 5.25 % of the total time, respectively. In the 4th and 5th zone, where the HR is above 77 % of HR_{max}, players were active 69.06 ± 19.4 and 22.42 ± 21.36 % of the total time. The mean figure of the HR during the total time in senior category reached 87.9 ± 3.6 % of HR_{max} (figure 1). When the intensity of specific game load between U19 and senior female basketball players, in individual intensity zones as well as in % of HR_{max}, was compared no statistically significant difference was recorded (p>0.05) (table 2).

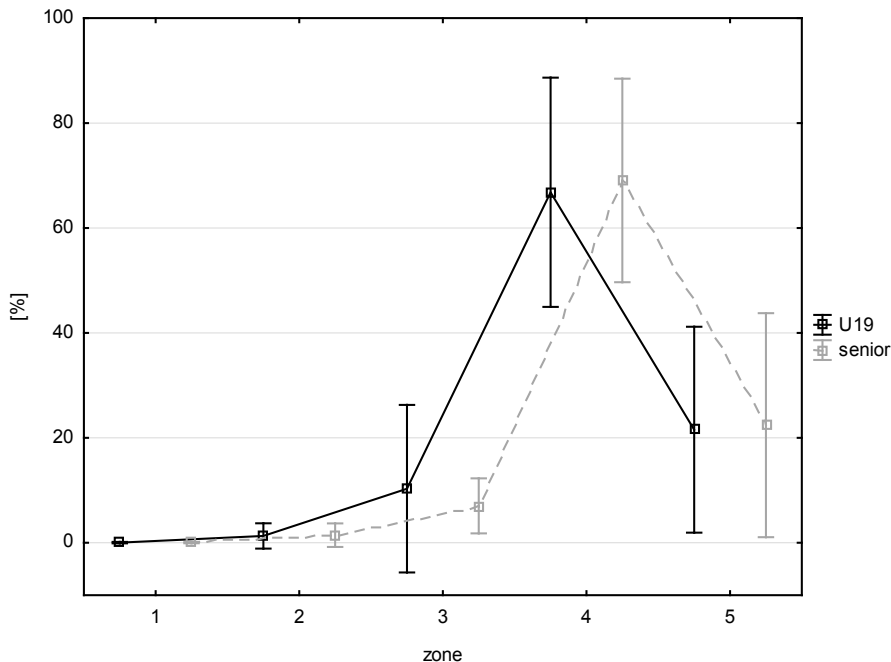


Fig. 1 Mean HR in individual zones of physical activity intensity of U19 and senior female basketball players

The mean HR during the game was 87.5 % in U19 and 87.9% in senior basketball players of HR_{max} of the total time, which correspond with 89.1 % of Matthew & Delestrat (2009). Rodriguez-Alonso et al. (2003) state similar values of mean HR in national competition (90.8 % of HR_{max}) and higher values of mean HR in international games (94.6 % of HR_{max}). However, Scanlan et al. (2012) detected lower values of mean HR on

state-level competition (71.8 % of HR_{max}). The range of mean HR reported in basketball game shows that physiological demands may vary according to various factors, such as gender, the level of competition, tactical strategies, speed of play, stoppages, the physical capacity of players and others (Abdelkrim et al., 2007; Scanlan et al., 2012). Even if no statistically significant difference was recorded ($p>0.05$) between the two categories, the results indicate high physiological demands on monitored female players of both categories during the game. HR can be influenced by many other factors (anxiety, spectators, etc.) and not only by intensity and duration of exercise. However, Bangsbo (1994) suggested that the effect of psychological factors on HR responses might be lower in high-intensity exercise. Monitoring HR, measuring of blood lactate concentration, and time-motion analysis can provide a compact view on the assessment of the game load intensity.

Tab. 2 Proportional values of HR in individual intensity zones

Category		Zone (%)					% of HR_{max}
		1	2	3	4	5	
U19	M	0.03	1.31	10.31	66.81	21.55	87.5
	SD	0.14	2.41	15.96	21.86	19.62	2.8
senior	M	0.02	1.45	7.03	69.06	22.42	87.9
	SD	0.12	2.25	5.25	19.4	21.36	3.6

Legend: M – mean, SD – standard of deviation

Conclusion

The results suggest high and almost identical physiological demands on monitored female basketball players during the game in both categories. Therefore, the transition, from the physiological (conditioning) point of view while excluding all other factors, from one category (the U19 1st division) to the other (the senior 2nd division) should be without complications. However, we assume that one should expect higher physiological (conditioning) demands in the senior category of the 1st division. The presented data could be very useful in training process and conditioning programmes for female basketball players, therefore, there may follow an improvement in the standard of play of both categories. To acquire more accurate results a higher number of measurements would be needed.

References

- Abdelkrim, N. B., Castagna, C., Jabri, I., Battikh, T., Fazaa, S. E. & Ati, J. E. (2010). Activity profile and physiological requirements of junior elite basketball players in relation to aerobic-anaerobic fitness. *Journal of Strength and Conditioning Research*, 24(9), 2330-2342.
- Abdelkrim, N. B., Fazaa, S. E. & Ati, J. E. (2007). Time-motion analysis and physiological data of elite under-19-year-old basketball players during competition. *British Journal of Sports Medicine*, 41(2), 69-75.
- Balčiūnas, M., Stonkus, S., Abrantes, C. & Sampaio, J. (2006). Long term effects of different training modalities on power, speed, skill and anaerobic capacity in young male basketball players. *Journal of Sport Science and Medicine*, 5(1), 163-170.
- Bangsbo, J. (1994). Energy demands in competitive soccer. *Journal of Sports Sciences*, 12, 5-12.
- McInnes, S. E.; Carlson, J. S.; Jones, C. J. & McKenna, M. J. (1995). The physiological load imposed on basketball players during competition. *Journal of Sports Sciences*, 13(5), 387-397.
- Matthew, D. & Delestrat, A. (2009). Heart rate, blood lactate concentration, and time-motion analysis of female basketball players during competition. *Journal of Sports Sciences*, 27(8), 813-821.
- Montgomery, P. G., Pyne, D. B. & Minahan, C. L. (2010). The Physical and Physiological Demands of Basketball Training and Competition. *International Journal of Sports Physiology and Performance*, 5, 75-86.
- Narazaki, K.; Berg, K.; Stergiou, N. & Chen, B. (2009). Physiological demands of competitive basketball. *Scandinavian Journal of Medicine & Science in Sports*, 19(3), 425-432.
- Robergs, R. A. & Landwehr, R. (2002). The Surprising history of the “ $HR_{max} = 220 - \text{age}$ ” equation. *Journal of Exercise Physiology*, 5(2), 1-10.
- Rodríguez-Alonso, M.; Fernández-García, B.; Pérez-Landaluce, J. & Terrados, N. (2003). Blood lactate and heart rate during national and international women’s basketball. *Journal of Sports Medicine and Physical Fitness*, 43(4), 432-436.

Scanlan, A. T., Dascombe, B. J., Reaburn, P. & Dalbo, V. J. (2012). The physiological and activity demands experienced by Australian female basketball players during competition. *Journal of Science and Medicine in Sport*, 15, 341-347.

Schönfelder, M., Hinterseher, G., Peter, P. & Spitzenpfeil, P. (2011). Scientific comparison of different online heart rate monitoring systems. *International Journal of Telemedicine and Applications*. vol. 2011, Article ID 631848, 6 pages. Retrieved September 6, 2013 from doi:10.1155/2011/631848.

Thompson, W. R., Gordon, N. F. & Pescatello, L. S. (Eds.). (2010). *ACSM's Guidelines for Exercise Testing and Prescription* (8th ed.). Baltimore, USA: American College of Sports Medicine.

Vala, R. & Litschmannová, M. (2012). Analýza intenzity zatížení hráčů v basketbalovém utkání – případová studie. *Česká kinantropologie*, 16(1), 81-87.

Vaquera, A., Refoyo, I., Villa, J. G., Calleja, J., Rodríguez-Marroyo, J. A., Garcia-López, J. & Sampredo, J. (2008). Heart rate response to game-play in professional basketball players. *Journal of Human Sport and Exercise*, 3(1), 1-9.

MISCELLANEOUS

The role of the teaching case studies in the sport management education

Jana Nová

Faculty of Sport Studies, Masaryk University, Brno, Czech Republic

Abstract

Teaching case studies are describing the problem situations that are occurring in the daily practice of sport organizations and the students are expected to assess the appropriateness or accuracy of the solution, which was adopted by the management of sports organizations or propose on the basis of information about the most appropriate solution / decision even using theoretical concepts from management theory. In the paper the author is discussing the importance of the teaching case studies which are in the current sports management studies and describes the approaches for their development based on the local sport context. The author underlines the importance of this educational tool also from the perspective of the European qualification framework learning outcomes and professional standards and offers the framework for the elaboration of the case studies which respects also the concept of the generational theory which is influencing the mode of accepting and processing the information in the teaching process of current students.

Keywords: case study, sport management, learning outcomes, professional standards, generational theory.

Introduction

The case studies and their appropriateness for educational purposes in sport management are recently widely discussed (Sanchis, 2007; Apostolopoulou, 2011; Dixon & McEvoy & McDonald, 2012). Firstly introduced at Harvard Business School traditionally the case studies have been an integral part of the business management education. The teaching case study is the description of the problem situations that are occurring in the daily practice of the organizations and from the students it is expected assessing the appropriateness or accuracy of the solution, or propose the most appropriate solution/decision based on the theoretical managerial concepts and available information. In sport management education discussion about the use of case studies in teaching started in 1959 when Earle, F. Ziegler (2002, p.29) implemented the text employing the Harvard case-method plan of teaching human relations and administration to the field of physical education and athletics. The growing importance of the case studies in teaching within the field of sport management has

been stressed recently at the Conferences of the North American Society for Sport Management in 2012 and 2013 where special roundtables were devoted to the Case Studies writing and teaching in Sport Management. The shortage of the outlets for sport management educators and researchers to publish case studies was discussed as well. The further evidence of the importance which is attributed to the development of the case studies in sport management has translated in the decision of the Human Kinetics to introduce a new on line journal called Case Studies in Sport Management in 2012 (<http://journals.humankinetics.com/cssm>). The new on line journal enables teachers not only to use the searchable library but also to contribute actively by publishing own studies.

Case studies have been also incorporated in the Sport Management Review journal and they provide instructors with valuable resources to develop and enhance the student's abilities and skills in accordance with the Blooms taxonomy (Bloom, 1956) – knowledge, comprehension, application, analysis, synthesis, evaluation.

Throughout of our review of the relevant literature we have identified that there is a lack of the relevant empirical and theoretical studies in sport's management literature in terms of the real or envisaged impact analyses of the case studies on the skills and knowledge development in relation to the EQF and professional standards which have been set for sports managers. Moreover teachers in higher education now are facing also the challenge which has aroused from the fact that the students population is changing as a result of existence of the "Millennial Generation". As it is stressed by Wilson and Gerber (2008, p.29) the Y generation bears internally complex set of traits consisting of ambition, confidence, optimism and capacity for high level cooperative reliance on parents. These traits call for the application of different teaching strategies.

The importance which is paid to the students' personal traits could be also underlined by the results of The 'Tuning' initiative, sponsored by the European Commission, which seeks to identify generic and subject-specific competences for first-cycle degrees within the European Higher Education Area. Business Group in Tuning 2 in his document Reference Points for the Design and delivery of Degree Programmes in Business (2009, p. 82 83) is strongly recommending to teachers to build a solid knowledge of how students learn (the process of learning): primarily concerning the cognitive domain (which deals with knowledge, comprehension, application, analysis, synthesis, evaluation) and the affective domain (which is concerned with attitudes, feelings, values, beliefs). Such matters as motivation of students, attention spans, how much learners remember (with consequent impact on forms and frequency of reinforcement and revision), how recall is affected by the mode of communication (e.g. through hearing or seeing), the impact of examples, how to promote independent learning skills etc. are important to effective teaching.

European Qualification Framework, learning outcomes and professional standards for sports managers

With regard to the implementation of the European Qualification Framework (EFQ) to the particular study and occupational level we have decided to use the example from United Kingdom (UK) as far as there could be find the linkage between the EQF, learning outcomes and national occupational standards for sports managers. Comparing to the situations in Czech and Slovak Republic in the UK documents in terms of the learning outcomes' description can be found as a result of the development of the Frameworks for higher education qualifications in England, Wales and Northern Ireland and also for Scotland. These documents contain the descriptors for each cycle of study (BA, MA and Ph.D.), known as the 'Dublin descriptors' which illustrate the typical abilities and achievements associated with qualifications that signify the completion of each cycle. In addition the Subject benchmark statements introduced by Quality Assurance Agency for Higher Education (QAA UK) provide a means for the academic community, to describe the nature and characteristics of programmes in a specific subject or subject area. They also represent general expectations about standards for the award of qualifications at a given level in terms of the attributes and capabilities that those possessing qualifications should have demonstrated. The relationship between the standards set out in the Subject Benchmark and those produced by professional, statutory or regulatory bodies for individual disciplines is a matter for individual HEIs to consider in detail.

In UK the professional standards for sport managers are set in The National Occupational Standards for Management and Leadership. The above mentioned documents will be used in our analyses of the contribution of the case studies to the development of the particular skills and competences required in the sport management.

Methods

Analyses of the availability of the case studies for sports management education in the Czech and Slovak Republic and the critical evaluation of the approaches used in elaboration of the case studies in local context. Based on the generational theory, the EQF learning outcomes and professional standards for sport managers (National Occupational Standards UK) to assess the educational potential of the case studies for current students' population in sport management education.

Results and Discussion

The availability of the relevant case studies for sport management education in the literature and academic journals is very rare in Slovak and Czech Republic. This is the result of the persistent misunderstanding and criticism of the role of teaching case studies (Shugan, 2006). But it can be observed also a growing interest in the use of the case studies for educational purposes (Sanchis, 2007, Apostolopoulou, 2011, Štrach, 2007, Musilová, 2003).

A case studies can be found on the commercial web portals (www.sportbiz.cz,) and these are mostly related to the marketing but their nature is rather descriptive so their usage for the educational purposes is limited and they need to be adjusted. Another example are the books devoted to the history of Czech and Slovak sports clubs, but these are quite complex description of the different aspects of the club realities so their usage for the educational purposes is limited. There is a significant gap in the relevant case studies for the management education in sport which should be filled and proper case studies should be developed following to methodology of the writing of the case studies so they could serve for educational purposes in tune with the Millennials traits.

In the academic year 2013/2014 the academic team at the Faculty of Sport Studies, Masaryk University in Brno, has decided to introduce within the study programme Sports Management a new subject – Case studies in sport management. This decision proved to be an academic challenge for all teachers involved in the delivery of the subject. At the very beginning we have faced twofold problem. Firstly we had to clarify the content of the case studies and secondly we found a critical lack of the relevant case studies in sport management in Czech or Slovak language. With regard to the content of the case studies we followed a concept of the usage of case studies in economics and management where the case studies are considered as a powerful educational tool for developing so called high skills level such as analysis, synthesis and evaluation, which are expected to be achieved at the Master level of study (Volpe, 2002, p.5).

Concerning the lack of the relevant case studies in local languages we have decided to overcome this shortage by adopting the following approaches:

1. Invitation of the external lecturers from different sports organizations to deliver the lectures and present their own case studies. This has been well received by the students as far as they have been given the opportunity to have a detailed insight into different topics.
2. Students have been requested to develop case studies based on their own experiences and interests.
3. The academic staff involved in the Sport Management study programme has been asked to develop a case studies based on their research expertize and focus.

4. Embedding the newspapers, focused news clips, reworked news, osmotic news clips into the lectures.
5. Generally we are also using the available case studies resources in English language such as Human Kinetic online journal and case studies displayed on Sport England/www.streetgames.org and the case studies available as a part of Sport Management Review journal.

The abovementioned approaches will provide us with the valuable sources for building our own database of case studies for different topics in sport management. Moreover using the resources available in English language the language competence of our students is enhanced. The case studies from respected foreign resources are also deemed as the valuable methodological frameworks when writing the case studies which are based on the context of Czech or Slovak sport environment.

In terms of the content and methodological approach towards the creation of our own case studies we would like to follow the logic of interdependence of the EFQ (learning outcomes), occupational standards and traits of our students (Generation Y). For these purposes we elaborated the table which displays this logic.

Tab. 1 Case studies and their contribution to the skills development

Learning outcomes UK descriptors for Sport programmes	National Occupational Standards UK for sports managers (leadership and management standard)	Y – traits the generational theory	Case study method contribution to the development of the skills
Making effective use of knowledge and understanding of the disciplines underpinning human structure and function	Enable colleagues and stakeholders to contribute towards setting a clear direction. Encourage a commitment to shared aims and objectives, within existing constraints	Team oriented Pressured	Workgroup Practical skills Time MGT
Appraising and evaluating the effects of sport and exercise intervention on the participant	Identify your customers' current and future needs and expectation and predicted future demands levels	Confident/ accepting the values	Critical evaluation/ judge the value of material for a given purposes
Showing evidence of the skills required to monitor and evaluate human responses to sport and/or exercise	Identify the reasons why customers use products and/or services from your organization rather than from your competitors Identify and assess current and future developments in our sector, including competitor's activities	Conventional/ accepting the values	Break down complex information, establish relationships and identify issues
Providing a critical appreciation of the relationship between sport and exercise activity and intervention in a variety of participant groups; this could include special populations such as senior citizens, disabled people and children	Use of a range of appropriate methods to communicate with colleagues and stakeholders. Identify and assess opportunities to expand into new markets and for innovations that meet customer's needs	Confident Seeks out creative challenges	Presentations skills in a variety of format Evaluation of alternative policies or strategies

Monitoring, analysing, diagnosing and prescribing action to enhance the learning and performance of the component elements of sport	Lead your area of responsibility to achieve agreed aims and objectives whilst overcoming challenges, developing solutions and capitalising on opportunities	Achievement oriented	Ability to break down materials into component parts so that the structure can be understood
Showing evidence of the skills required to monitor and evaluate sports performance in laboratories and/or field settings	Identify and assess any threats to, and weaknesses in, your organization's product and services	Purposeful	Information gathering and analysis/ resource investigation
Displaying a critical appreciation of the integration of the variables involved in the delivery (teaching, instructing and coaching) of enhanced sport performance	Empower colleagues to develop their own ways of working and take their own decisions within agreed boundaries in an environment of trust and respect. Apply leadership style that are appropriate to people and situations	Creative Multi taskers	Development of the individual study skills, carrying out independent research

Source: Own elaboration

Conclusions

In our paper we have exploited the nature of the one of educational tools-case studies for explaining of their importance in the process of development of student's skills. When defining the skills which are expected to be achieved after the graduation of the study programmes in sport management, we have linked the learning outcomes and occupational standards for sport managers. The required skills then have been combined with the personal traits of the current students' population – as their natural predispositions in learning process. At the end we have described how the case studies could contribute to the development and enhancement of the desired skills bearing in mind the traits of the Y generation. It is recommend taking into consideration this logic when preparing the case studies for the education of the future sports managers.

References

Apostolopoulou, A. (2011). Ten years of integrating Research and Practice Perspectives: A Guide to Sport Marketing Quarterly Case Studies. *Sport Marketing Quarterly*. 20(4), 227-241.

Bloom, B. S. & David R. Krathwohl. (1956). *Taxonomy of educational objectives: The classification of educational goals, by a committee of college and university examiners. Handbook 1: Cognitive domain*. New York, Longmans.

Dixon, J. at al. (2012). *Writing Case Studies in Sport Management*. North American Society Management Conference (NASSM 2012). Roundtable, Seattle, WA. Conference Proceedings May 23-26, 2012.

Musilová, M. 2003. *Případové studie jako součást pedagogické praxe*. 2. Vyd. Olomouc. Univerzita Palackého v Olomoci, 42 s. ISBN 80-244-0749-3.

Sanchis, C. M. (2007). The case studies method: a powerful teaching tool in sports marketing education. *International Journal of Sports Marketing and Sponsorship*. October 2007. 7-10.

Shugan, S. M. 2006. Editorial: Save research – Abandon the case method of teaching. *Marketing Science*. 25(2), 109-115.

Štrach, P. 2007. Tvorba výukových a výzkumných případových studií. *Acta Oeconomica Pragensia*. 15 (3), 22-36.

Wilson, M. and Gerber, L. E. (2008). How Generational Theory Can Improve Teaching: Strategies for Working with the “Millennials”. *Currents in Teaching and Learning*. 1(1), 29-44.

Web resources

Business Group in Tuning: Reference Points for the Design and delivery of Degree Programmes in Business (2009): Retrieved from: <http://www.unideusto.org/tuningeu/publications/253-reference-points-for-the-design-and-delivery-of-degree-programmes-in-business.html>

European Qualification Framework. Retrieved from: <http://ec.europa.eu/eqf>

Volpe, G. 2002. Case Studies. The Handbook for Economics Lecturers. Retrieved from: http://www.economicsnetwork.ac.uk/handbook/printable/casestudies_v5.pdf

Frameworks for higher education qualifications in England, Wales and Northern Ireland and also for Scotland. Retrieved from: <http://www.qaa.ac.uk/AssuringStandardsAndQuality/Qualifications/Pages/default.aspx>

National Occupational Standards UK. Retrieved from: <http://www.skillsactive.com/our-sectors/sport/national-occupational-standards>

www.sportbiz.cz

www.streetgames.org

<http://journals.humankinetics.com/cssm-mission-statement>

Zeigler, E.F. (2007) An Encounter with Management in Physical Activity Education and Sport. Retrieved from: <http://www.nassm.com/InfoAbout/NASSM/History>

Implementation of core stability programme for footballers in middle school aged

Ivan Struhár; Lenka Dovrtělová

Faculty of Sport Studies, Masaryk University, Brno, Czech Republic

Abstract

The main aim of this study was to show that core stability training could have much more beneficial effects than conventional exercise. The core stability could reduce back pain which can be demonstrated not only in adulthood but in childhood as well. Many studies have already shown that all powerful movements originate from the center of body out. Twenty-one participants were assigned to a control group (10 boys; mean age=11.9±0.3 years; mean height=1.57±0.08 m; mean body weight=46.21±10.9 kg) and experimental group (11 boys; mean age=11.5±0.4 years; mean height=1.56±0.06 m; mean body weight= 41.6±5.48 kg). The core stability program was a part of physical education class 3 times a week for 5 months. The control group was without any form of core stability programme for 5 months. All participants were measured after 5 months. One minute sit-up test was used to measure the core musculature strength. One of the aims of our study was to decide if we can observe differences between beginning and final measurements in experimental group. We supposed that there will not be seen any changes. The alternative hypothesis was contrary to the null hypothesis. We used t-test for paired samples ($p=0.000002$). We accepted the alternative hypothesis. Trunk muscle endurance in the experimental group was significantly better than trunk muscle in the control group after 5 months ($P<0.05$). Our results showed that core stability program was more effective in improving trunk muscle endurance.

Keywords: injury, core endurance, sit-up test.

The work was supported by European operational program Education for Competitiveness Cz.1.07/2.4.00/17.0039, Creation of a Network of Professional Institutions Participating in the Fight against the Occurrence of Metabolic Syndrome.

Introduction

Football is probably the most popular game in the world. Unfortunately, the football is often associated with injuries which can cause health problems for players. One of the ways how to avoid them is core stability programme which can

be part of every training. Injuries have great impact not only for player's health but on performance of team as well. There is a evidence between lost matches and higher incidence of injuries (Ekstrand, Walden, & Hagglund, 2004).

Sprints, jumps, kicks and running are dominant activity in football. Strong core can allow the full transfer of force from the ground through the lower extremities, the trunk into the upper extremities (Behm, Leonard, Young, Bonsey, & MacKinnon, 2005).

The core stability exercises play an important part of injury prevention involving the back, hamstrings, knee or groin. It is recommended to train the anatomical core in prevention of injuries (McGill, 2010). The core is often seen as a corset that stabilizes especially the spine with or without limb movement (Akuthota & Nadler, 2004).

The anatomical core is described as a box of muscles which consists from the abdominal muscles, paraspinal and gluteal muscles, the diaphragm, the pelvic floor and hip girdle muscles (Richardson, Jull, Hodges, & Hides, 1999).

The power is generated from the core and then it is translated to the extremities (Vleeming, Pool-Goudzwaard, Stoeckart, Van Wingerden, & Snijders, 1995). The stability and control requires to include muscle stabilization of the abdominal, paraspinal and gluteal muscles (Nadler et al., 2002).

The core stability programme usually does not require any equipment so it means it can be trained at home. The exercises are often focused of a whole body workout which is often included in. The role of core stability muscles plays an important part in movements. The core stability is often shown as a key component in training which can improve health and physical performance (Liemohn, Baumgartner, & Gagnon, 2005). The core stability programme is often recommended in athletic training (Standaert, Herring, & Pratt, 2004). The benefits of stable core include especially reducing risk of injury, improving body posture and stability and improving fitness as well.

Methods

Twenty-one participants volunteered for this study. The participants were assigned to a control group (10 boys; mean age=11.9±0.3 years; mean height=1.57±0.08 m; mean body weight=46.21±10.9 kg) and experimental group (11 boys; mean age=11.5±0.4 years; mean height=1.56±0.06 m; mean body weight=41.6±5.48 kg). Participants were physically active which we demonstrated as sustain physical activity >3 times per week. All participants were involved in physical education class. One of the important facts of our study was that participants had to be without any musculoskeletal injuries. Participants also had no experience with a core stability training during physical education class or football training. The core stability

programme for experimental group started in February and it was ended in June. The core stability programme was a part of physical education class 3 times per week for 5 months. The control group was without any form of core stability programme for 5 months. All participants were measured after 5 months. One minute sit-up test was used for measuring the core musculature strength. If the participant could not perform the core stability training programme, he/she was excluded from our study.

We used one minute sit-up test of measuring abdominal strength and endurance in our study. This test requires to perform as many sits-up as possible in 1 minute. The protocol for one minute sit-up test was the same for all participants. Participant was tested on the floor in the supine position with the knees bent. Partner held feet. Then a timer called out the signal “Go!” which meant beginning of timing. The participant stopped on the word “Stop!”.

Arms had to be crossed with hands placed on opposite shoulders and elbows held close to chest. For one sit-up, elbows had to touch their thighs and then participant had to lower to the floor so that shoulder blades had to touch the floor. Partner counted only the number of correct sit-ups. The total number of sit-ups was recorded in 1 minute. Before the testing, the participants had the opportunity to try one minute sit-up test.

Participants did warm-up exercises before starting core stability programme. At the end of workout, participants stretched their muscles which were used during the workout. If participants were not able to hold the position, they could hold the position as long as possible and then rest for 4 seconds. After that they continue with holding the position until remaining time. The participants were also challenged with more and more difficult tasks. Each exercise was explained and demonstrated, including the correct contraction of muscles. The core stability programme contained 4 core stability exercises:

- 1. 4-point kneeling.** Knees are underneath hips and hands underneath shoulders. Participants lift one leg and the opposite arm off the floor and hold this position for 5 seconds and then alternate arms and legs. Participants perform 3 sets of 10 repetitions. We focused on the spine position. We also controlled pelvis and spine which cannot collapse down towards the floor.
- 2. Plank.** The participants lie on their stomach with their elbows under their shoulders. Palms are down with fingers facing forward. Then, participants lift their belly from the floor and then lift their hips off the floor. The main pressure is on elbows and toes. We pay attention to maintain a neutral spine position. Participants hold this position for 20 seconds for three repetitions.
- 3. Twist on ball.** The participants sit on the stability ball then they begin to walk away from the ball (until head, upper back and shoulders rest on the ball) and then participants

rotate body to one side. The movement is initiated at the core. When participants reach end range, they start to rotate in the opposite direction. Participants perform 3 sets of 15 repetitions.

4. **Bridge.** The participants start the exercise on their back, with arms resting at sides. Then, the participants activate the abdominals and the gluteal muscles. After that, they lift the pelvis and hips off the floor. The hips, the knees and shoulders should create a straight line. We focus on maintaining neutral lumbar alignment. Participants hold this position for 10 seconds for 7 repetitions in 3 sets.

Results

Tab. 1 The mean age, height and weight for all participants

Participant group	Age (years) Mean	Height (m) Mean	Weight (kg) Mean
Experimental (n=11)	11.5±0.4	1.56±0.06	41.6±5.48
Control (n=10)	11.9±0.3	1.57±0.08	46.21±10.9

At the beginning of our study we wanted to decide if the control and experimental groups are homogenous. We supposed that groups are homogenous. That was the null hypothesis. The alternative hypothesis was contrary to the null hypothesis. We used independent t-test ($p=0.365944$). We did not reject the null hypothesis.

One of the aims of our study was to decide if we can observe differences between beginning and final measurements in experimental group. We supposed that there will not be seen any changes. The alternative hypothesis was contrary to the null hypothesis. We used t-test for paired samples ($p=0.000002$). We accepted the alternative hypothesis.

Trunk muscle endurance in the experimental group was significantly better than trunk muscle in the control group after 5 months ($P < 0.05$).

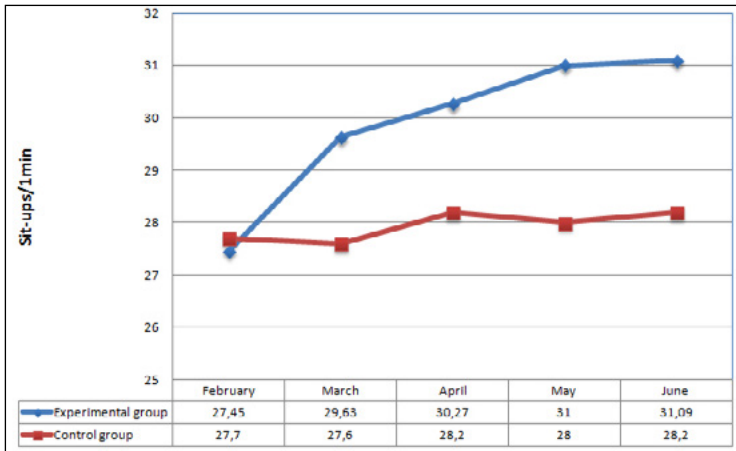


Fig. 1 The mean of sit-ups from February until June in both groups

For this data set, we used one-way ANOVA. In the first case, we compared measurements in the experimental group (from February to June), it was proved statistical significance ($p=0.003895$). In the second case, we compared measurements in the control group ($p=0.98733$). The control group was without significant difference. The data revealed that the biggest progress in experimental group was during the first 2 months of core stability programme. Weak core muscles could result in a low back pain. Maintaining appropriate posture demands balanced core muscles not only the fact of strong muscles. All movements start from the centre of the body out. At the beginning of any movement, the spine should be stable. As a result of the athletic performance requires core muscles as strong and balanced as possible.

Discussion

We decided to create the core stability programme with the aim of improving core strength and endurance for footballers in middle school aged. We are convinced that the core stability programme should be part of every training. The most of the training time in football is spend on training of legs which can be considered as the main problem of injuries. The muscles which are included in the system of core muscles are powerhouse between the upper and lower extremities. As a result of decreased core stability can predispose injury from overcompensation of the extremities (Zazulak, Cholewicki, & Reeves, 2008).

We mentioned that the biggest progress was during the first 2 months of core stability programme. We supposed that fact but we wanted to create a training regimen of core exercises. Training of children should include many facts especially enjoying. Participants reported that performing core stability programme was more fun than typical exercise. The core exercises have many advantages which can be used in training of children, for example improving movement efficiency and it can decrease the time of reactions to unexpected events in training or match.

Conclusions

Core stability has become a well-known fitness term. It is included in many programmes such as yoga or pilates. The importance of core muscles for body stabilisation is discussed topic in sport. We did not want to show that strengthening of core muscles is the most important part of training. If core muscles are able to work together, we suppose that it can increase the efficiency of movement patterns. Muscles which are often called as a core are responsible for supporting postures and absorbing force. Our results show that trunk muscle endurance was significantly better in the experimental group than trunk muscle in the control group after 5 months.

References

- Akuthota, V., & Nadler, S. F. (2004). Core strengthening. *Archives of physical medicine and rehabilitation*, 85(3 Suppl 1), S86-92.
- Behm, D. G., Leonard, A. M., Young, W. B., Bonsey, W. A. C., & MacKinnon, S. N. (2005). Trunk Muscle Electromyographic Activity with Unstable and Unilateral Exercises. *Journal of Strength & Conditioning Research* (Allen Press Publishing Services Inc.), 19(1), 193-201.
- Ekstrand, J., Walden, M., & Hagglund, M. (2004). Risk for injury when playing in a national football team. *Scandinavian Journal of Medicine & Science in Sports*, 14(1), 34-38.
- Liemohn, W. P., Baumgartner, T. A., & Gagnon, L. H. (2005). Measuring Core Stability. *Journal of Strength & Conditioning Research* (Allen Press Publishing Services Inc.), 19(3), 583-586.
- McGill, S. (2010). Core Training: Evidence Translating to Better Performance and Injury Prevention. *Strength & Conditioning Journal* (Lippincott Williams & Wilkins), 32(3), 33-46.
- Nadler, S. F., Malanga, G. A., Bartoli, L. A., Feinberg, J. H., Prybicien, M., & Deprince, M. (2002). Hip muscle imbalance and low back pain in athletes: Influence of core strengthening. *Medicine and Science in Sports and Exercise*, 34(1), 9-16.
- Richardson, C., Jull, G., Hodges, P., & Hides, J. (1999). *Therapeutic exercise for spinal segmental stabilization in low back pain: scientific basis and clinical approach*. Edinburgh; United Kingdom: Churchill Livingstone.
- Standaert, C. J., Herring, S. A., & Pratt, T. W. (2004). Rehabilitation of the athlete with low back pain. *Current sports medicine reports*, 3(1), 35-40.
- Vleeming, A., Pool-Goudzwaard, A. L., Stoeckart, R., Van Wingerden, J. P., & Snijders, C. J. (1995). The posterior layer of the thoracolumbar fascia: Its function in load transfer from spine to legs. *Spine*, 20(7), 753-758.
- Zazulak, B., Cholewicki, J., & Reeves, N. P. (2008). Neuromuscular control of trunk stability: clinical implications for sports injury prevention. *The Journal of the American Academy of Orthopaedic Surgeons*, 16(9), 497-505.

Discourse on curriculum development in physical education, recent development in Europe

Petr Vlček

Faculty of Education, Masaryk University, Brno, Czech Republic

Abstract

The curricular revisions are currently being in process in several countries in the European Union. The process of planning, projecting and designing national curriculum has always encountered various problems concerning also physical education. Although the subject has always played a very specific role in education and although it has been a compulsory subject in primary and lower secondary education throughout the countries in Europe, its position cannot be described as equivalent in comparison to other subjects.

One possible concept how to achieve a quality physical education equal to other subjects is to standardize physical education in curricular documents, which could stress the importance of the subject (Krick, 2006). However, to accomplish this task is more difficult than someone would think.

The paper tries to identify the principal problems of physical education curriculum development and presents a short introduction to planning and designing physical education aims, outcomes and standards in chosen countries.

Methodology is based on Comparative physical education and Sport. We describe the recent development of physical education concepts and curricula in the Czech Republic, German speaking countries, Slovakia and the USA. As a method of our research we have chosen the qualitative analysis of texts. Švaříček and Šed'ová (2007) describe particular steps of this method. We also use information gained from members of professional groups developing the national curriculum in the selected countries.

Keywords: *Physical Education, Curriculum, European countries, USA.*

Introduction

The effort to provide the opportunity for physical exercise at school appears simultaneously with the origin of the demand for universal education, which was promoted by J. A. Comenius (Antala, et al., 2001; Jurkechová, Vlček & Bartík, 2011). However, various circumstances disallowed the effort to come into real practise, and physical education appears in the curriculum only later. The concepts of physical education in different countries were diverse throughout the history. In our article we

agree with Naul (2003) who admits that different and various concepts of the subject exist in terms of the curriculum. The status of Physical Education has developed as the years passed. In our considerations we also agree with Brettschneider et al. (1997) and many other authors (Cazers & Miller, 2000; Kössel, Štumbauer & Waic, 2004; Siedentop, 2006) that from the late 17th century to the mid-18th century three systems (the German, Swedish, and English) laid foundations of sport and physical education in many countries across the world. Naul (2003) recognises four concepts of PE (sport, movement, physical and health) which developed in the 19th century and are more or less predominant in various countries today. In contrast to Naul (2003), who paid attention mostly to the western European countries, in our paper we would like to add some more current components from the Czech point of view and partly compare them with other countries.

The curricular revisions are currently being in process in several countries in the European Union and the USA. The process of planning, projecting and designing national curriculum has always encountered various problems. Although physical education has been a compulsory subject in primary and lower secondary education throughout the countries, its position cannot be described as equivalent in comparison to other subjects.

One possible concept how to achieve a quality physical education more equivalent to other subjects is to standardize physical education in curricular documents, which could emphasize the importance of this subject (Krick, 2006). However, to accomplish this task is more difficult than someone would think and furthermore, it is not much discussed in the context of physical education. As we feel the need for professional discussion on this kind of topic, in our paper we introduce the recent development of curriculum and potential student testing as an issue concerning also physical education.

Methods

The paper tries to identify the principal problems of physical education curriculum development and presents a short introduction to planning and designing physical education aims, outcomes and standards in the Czech Republic. We shortly compare curriculum situation with other countries, especially Slovakia, European German speaking countries and the USA.

The theoretical and methodological bases of the presented study are based on the discipline which in English language is called “Comparative physical education and Sport”. In German literature the same discipline is called „Vergleichende Sportpädagogik“ (Kaulitz, 2001). The discipline was first mentioned by Bennett (1970). Lately, the comparisons in the sphere of physical education have been in the centre of attention more

and more, especially by authors writing in English and German languages, which can be seen from the number of professional contributions dealing with the methodology of comparative research (Hardman, 2000; Kaulitz, 2001; Kudlorz, 1989; Pühse & Gerber, 2005), but also from rapidly increasing number of comparative studies which are focused on various spheres of physical education and sports.

Hagg (1989) determines two dimensions of comparative research in physical education:

Horizontal – comparison of different social environs in a given time.

Vertical – comparison of different time periods in the view of individual topics.

We describe and compare especially the recent development of physical education concepts in various countries – horizontal approach. As a method of our research we have chosen the qualitative analysis of texts especially RVP ZV (2007) and similar documents from the foreign countries. We also use our own information that we experienced as the members of the professional groups developing the national curriculum in 2012 and 2013. And we use data from other research studies and congress discussions (in Vlček & Janík, 2010; Masaryková & Vlček, 2013; X. Sommerakademie viz Vlček, 2012 and others)

We pay attention mainly to the elementary school physical education level – ISCED 1.

In the following part we first describe the resent situation in the Czech Republic. Afterwards we discuss some similarities and differences between the Czech Republic and foreign countries.

Results

After the year 1989 the political, structural and economic reforms caused significant changes in education of the Czech Republic effecting also physical education. The government later decided to reform national curricula. The aim was to nearer the Czech education to western European countries. The curricula changes also affected physical education. After almost 20 years the educational changes are being evaluated and the Czech curriculum is currently being revised.

Recent development of physical education curricula in the Czech Republic

According to the latest national curriculum papers named the Framework Education Programmes (in Czech Rámcové vzdělávací programy – RVP ZV, 2007) each elementary and secondary school was supposed to create its own programmes on basis of the national curricula in order to match specific school circumstances, regional traditions and educational purposes. Reforming process of the curricula has been criticized by teachers for the low support of the Ministry of Education, Youth

and Sport (MEYS, MŠMT in Czech), weak co-ordination, formalism, and low activity of the academic community (Janík et al, 2011) which resulted in low acceptance of the curricular reform among the teachers and worsening study results of Czech pupils. As a result of the recent unsatisfactory study results of Czech pupils, the Ministry of Education, Youth and Sports decided to start developing new educational standards. These should be based on the framework education programmes. Thus, the development of the standards as well as the testing of the study results have recently become a very important issue in the Czech Republic.

Development of educational standards in the Czech Republic

Based on the decision of Minister of Education, Youth and Sport from 1st of September 2013, the Framework Education Programmes (RVP ZV, 2007) should be changed and educational standards should be implemented to it.

The standards for Math, Czech language and English were created as first. In October 2012 professional groups for the development of the educational standards for other subjects were created and the standards are now only being formally finalised as the groups were supposed to finish their work until the end of June 2013. According to the Ministry of Education, Youth and Sport experienced educational experts, academic representatives and representatives of the Ministry of Education, Youth and Sport and other educational institutions were chosen to form the members of the professional groups. The group developing the standards for PE consisted of a MŠMT guarantor, a NUV¹ guarantor, three academic representatives² and three representatives of the basic schools. The task of this group was to develop the educational standards for PE until the end of April 2013.

It is important to point out, that for the development of the standards, there was no empirical evidence available and the Framework Education Programmes were originally formulated without the assumption of the future standards extension. Therefore, the educational outcomes defined in the curricular documents apart from skills and theoretical knowledge contain also attitude and behavioural outcomes. Thus, according to the Framework Education Programmes the PE educational content is difficult to achieve and to evaluate.

Based on the research results it is evident (Vlček & Mužík, 2012) that the current conception of the Czech PE is not accepted homogenously. According to the latest educational programmes mentioned above (Framework Education Programmes – RVP ZV, 2007) a wide variety of PE activities concerning especially health targets should be used in the PE classes (Mužík, 1999). However, there is a low congruence between the projected and realised curricula (Vlček & Mužík, 2012) which presents a significant problem for the quality evaluation of the subject (Egger, 2002).

1 Národní ústav pro vzdělávání: <http://www.nuv.cz/>

2 Among them also belonged one of the authors of this article.

Discussion

In the following paragraphs, we compare some chosen issues concerning physical education curriculum in the Czech Republic and the other chosen countries:

- All countries are revising PE curriculum at the moment. They use some common but also different approaches in the curricular projection.
- The countries use a similar structure of the curricular documents – national level and school level.
- The Czech and USA documents could be described as more outcome based whereas the Slovak and German curriculum concentrates more on the content.
- The countries have chosen different approaches toward the incorporation of the standards into the curricular hierarchy. The USA curriculum is based mainly on standards, in Slovakia and the German speaking countries the standards were projected at the same time as the whole projected curriculum whereas the Czech standards were done separately.
- Czech goals of physical education concentrate more on health issues whereas physical education goals of the other countries are more diverse.
- The educational reforms in Germany and the USA were started 10 and 20 years earlier than in the Czech Republic.
- Because the curriculum of the chosen foreign countries has (more or less) recently been revised and the Czech curriculum has not come through this process yet, there is a better congruence between the projected PE goals, content and standards in the foreign countries, than in the Czech Republic.
- There are different approaches to physical education concept among the countries in terminology, roles, and goals of physical education. If we consider the four main ways of the development of physical education (sport, motional, physical and health), which were suggested by Naul (2003), and compare the conception of the countries concerned, we can say that the conception of physical education in all countries is highly oriented toward motor development, while the USA conception lays a greater emphasis on the development of lifelong motional activities, the curriculum of German speaking countries concentrates on operation ability (Handlungsfähigkeit) and Slovakia and especially Czech curriculum concentrates on the development and keeping pupils in good health.

Conclusion

In our paper we have tried to describe and later compare the process of curriculum and standards development in the Czech Republic and some other countries. We wanted

to present some ways which are partially similar but also very different. We cannot say at the moment which way is better or will be more successful, however we believe that international cooperation and discussion can help to improve the process of curriculum development thanks to exchanging valuable experience. Still we need to bear in mind that the curriculum is one thing and the reality is different from the theory.

All countries have been dealing with the same problems in recent decades concerning physical education. Many scientific reports have pointed out that in spite of the extensive warnings from health organisations, a large number of children and adolescents do not engage in regular physical activity (Frömel & Bauman, 2006; Hrčka & Drdäcká, 1992; Wolf, Manson & Coldiz, 2003). According to many professional reports about the situation and future of physical education (Hardman, 2003; Hardman & Marshall, 2000, and others), it is not difficult to judge that our teachers will face one of the most difficult periods in history. The ongoing educational reforms in all countries, which clearly support health and active life style (Feingold & Fiorentino; 2005; Richter, 2007; Vlček, 2009), can therefore be regarded as a promising reaction.

However, in spite of globalization, it seems that in the pedagogic community there is no agreement on the understanding of the importance, functions and contents of school physical education. In designing the concept of physical education, cultural specificity plays an important role. Nevertheless the ducational reforms in the USA and also Germany have been in progress for a longer time than in the Czech Republic and we can get valuable information which can help us to reform our school system including physical education. A careful study and understanding of the curriculum and standardization of physical education in different countries is a prerequisite to a full understanding of the overall situation.

References

- Antala, B. et al. 2001. Didaktika školskej telesnej výchovy. Bratislava: Fakulta telesnej výchovy a športu Univerzity Komenského. S.17-34.
- Bennett, B. L. (1970). A Historian Looks at Comparative Physical Education. *Gymnasium*, 7, 10-13.
- Cazers, G., & Miller, G. (2000). The German Contribution to American Physical Education: A Historical Perspective, *JOPERD*, 71(1), 44-48.
- Feingold, R., S. & Fiorentino, L. (2005). United States of America, In U. Pühse & M. Gerber (Eds.). *International Comparison of Physical Education* (pp. 699-713). New York: Mayer & Mayer.
- Frömel, K., & Bauman, A. (2006). Intenzita a objem pohybové aktivity 15-69leté populace České republiky. *Česká kinantropologie*, 10(1), 13-27.
- Haag, H. (1989). Sportpädagogik. In Haag, H., Strauss, B., & Heinze, S. *Theorie und Themenfelder der Sportwissenschaft: Orientierungshilfen zur Konzipierung sportwissenschaftlicher Untersuchungen* (pp. 48-69). Schorndorf: Hofman.
- Hardman, K. (2003). Worldwide survey on the state and status of physical education in schools: Foundations for deconstruction and reconstruction of physical education. In Hardman K., (Ed.), *Physical Education: Deconstruction and reconstruction – Issues and directions* (pp. 15-34). Schorndorf: Hofmann.
- Hardman, K., & Marshall, J. (2000). The State and Status of Physical Education in Schools in International Context. *European Physical Education Review*. 6(3), 203-229.
- Hrčka, J., & Drdácká, B. (1992). *Rekreační tělesná výchova a sport*. Bratislava: SPN.
- Janík, T., Najvar, P. & Solníčka, D. (2011). Od idejí k implementaci: kurikulární reforma v rozhovorech s řediteli (nepilotních) gymnázií. *ORBIS SCHOLAE*, 5(3), 63-85.
- Jurkechová, M., Vlček, P. & Bartík, P. (2011). Development of school physical education in Slovakia and in The USA, *Acta Facultatis Educatione Universitatis Comenianae*. S. 17-31.

Kaulitz, B. (2001). Vergleichende Sportpädagogik. In H. Haag, & A. Hummel (Eds.), *Handbuch Sport-pädagogik* (pp. 95-104). Schorndorf: Hofman.

Kössl, J., Štumbauer, J., & Waic, M. (2004). *Vybrané kapitoly z dějin tělesné kultury*. Praha: Karolinum.

Krick, F. (2006). Manuskript für ein themenheft über qualiät im schulsport – Bildungsstandards im Sportunterricht – Risiken und Chancen, Sportunterricht. Retrieved December 8, 2010, from http://www.uni-frankfurt.de/fb/fb05/ifs/-sportpaedagogik/Mitarbeiter/Krick/2006_Krick_Bildungsstandards_im_SpU.pdf

Kudlorz, P. (1989). Comparative Physical Education: An International scientific Approach. *International Review of Education*, 35(1), 65-72.

Masaryková, D., Vlček, P. (2013). Discours about curriculum development in physical education, 8th FIEP European congress, Bratislava.

Muzik, V. (1999). Gesundheitlich vorbeugende Körpererziehung – eine neue Richtung in der tschechischen Schule. In: J.C. Bussard & F. Roth (Ed.), *Which Physical Education for which School?* (pp. 91-96). Berne: SVSS.

Naul, R. (2003). Koncepce školní tělesné výchovy v Evrope. *Česká kinantropologie*, 7(1), 39-53.

Pühse, U., & Gerber, M. (Ed.), (2005). *International Comparison of Physical Education*. New York: Mayer&Mayer.

Rámcový vzdělávací program pro základní vzdělávání – RVP ZV (2007). Výzkumný ústav pedagogický v Praze. Retrieved July 8, 2009 from: http://www.vuppraha.cz/soubory/RVPZV_2007-07.pdf

Richter, CH. (2007). Concepts of Physical Education in Europe: Movement, Sport and Health. *International Journal of Physical Education*, 44, 101-105.

Siedentop, D. (2006). *Introduction to Physical Education, Fitness, and Sport*. McGraw Hill.

Švaříček, R., & Šed'ová, K. et al. (2007). *Kvalitativní výzkum v pedagogických vědách*, Praha: Portál.

Vlček, P. (2009). Vliv školských reforem na tvorbu kurikula tělesné výchovy v České republice, Spolkové republice Německo a Spojených státech amerických. Disertační práce, Univerzita Palackého, FTK: Olomouc.

Vlček, P., Janík, T. (2010) Školské reformy a tvorba kurikula tělesné výchovy v České republice, Spolkové republice Německo a Spojených státech amerických. 1. vyd. Brno: Paido.

Vlček, P., & Mužík, V. (2012). Soulad mezi projektovaným a realizovaným kurikulem jako faktor kvality vzdělávání v tělesné výchově. *Česká kinantropologie*, 16(1), 31-45.

Wolf, A., M., Manson, J., E., & Colditz, G., A. (2003) The Economic Impact of Owerweight, Obesity, and Weight loss. In R. H. Eckel (Ed.), *Obesity: Mechanisms and Clinical Management* (pp. 6). Philadelphia, PA: Lippincott, Williams & Williams.

Heart rate changeability in representation lessons of physical education

Jaroslav Vrbas

Faculty of Education, Masaryk University, Brno, Czech Republic

Abstract

In the research contribution we deal with relation between development of heart rate in model P. E. classes and optimal development of heart rate described in professional publications.

The contribution Changes of heart rate in P. E. (physical education) model classes focuses on obtaining knowledge related to intensity of physical exercise considering heart rate in P. E. classes led by future teachers. Theoretical bases rely on pedagogical kinanthropology and focus on contents, structure and effectiveness of P. E. class on the first grade of primary school (ISCED 1). The main theoretical base which is related to P. E. didactics is a set of methods of observing efficiency of P. E. class. The main method of the empirical research is to monitor changes in heart rate of pupils, which complements the Method chronometry (measuring time use in physical education classes). This is a simple method for medico-pedagogical observations, appropriate to determine the physiological effect of exercise and time relations activities of students in physical education classes (Mužík, 1991; Fialová, 2010). When processing data obtained from empirical research, we investigated the hypothesis based on relational problem. Character of the data led to the use of specific statistical methods. According to the obtained results it can be concluded that there is relation between tested physiological heart rate curves in one quarter and physical activity of students during model P. E. classes of elementary school was as close as one quarter to the criteria for optimal physical activity and heart rate development described in professional publications. Empiric research and its statistic elaboration brings knowledge from the field of pre-gradual preparation of Pedagogy/Tutorship for the first grade of primary school students with P. E. specialisation.

Keywords: *Didactics, Physical Education, Physiological curve, Methods, Heart rate.*

Introduction

Didactics of Physical Education at the first grade of primary schools, as a study subject in undergraduate preparation of Physical Education (P. E.) teachers has an

extensive content. One of the possible viewpoints is the research focused on the optimal physical activity of pupils of younger school age in relation to the content of a school P. E. lesson. In the paper, we focus on the undergraduate training of students of physical education and their effective management of a lesson from the point of view of measuring the heart rate. One of the objectives of the paper is to introduce/present a method, by means of which we can immediately give feedback concerning the relation between the development of heart rate and the lesson content.

The paper is based on the academic literature and researches which we attempt to follow. One of the most recent publications has been written by Fialová (2010), talking about current topics in the didactics of school physical education. An important aspect is that the author highlights the need for research on school physical education, the dissemination of research methods and application of their results in practice. The basic theory is presented by Mužík (1991). He presents here the didactics of Physical Education as a scientific discipline comprising the didactic process, didactic methods and forms, describes the specific content of a lesson, and presents options for the assessment of teaching activities of the teacher. In this publication, the term of the physiological curve of heart rate is introduced, based on which we can evaluate the distribution and the intensity of physical activity of pupils in a P. E. lesson. Frömel (1991) deals in his publication with the questions of how to fulfil the challenging tasks of Physical Education didactics and how to remedy the imperfections in the didactic process.

He ranges programmed instruction in physical education among the means enabling to deal with these situations. In these conditions, the teacher has the space to concentrate on students individually, and thus improve the effectiveness of the lesson. Physical activities of pupils in Physical Education lessons are monitored also by Frömel, Novosad and Svozil (1999). Physiological curve track the intensity of load of girls and boys in the senior school age. Physiological curves follow the intensity of activities of girls and boys of older school age. Physiological effectiveness of the lesson is surveyed by Vilímová (1997) as well. She mentions the method of tracking the changes in heart rate as the most accurate and the easiest method. She also suggests measurement techniques using the sport tester and the palpation method and considers these ways suitable for use in school physical education.

In the paediatric literature we can encounter publications describing the specific features of the heart rate in paediatric age. One of the authors is Javorka et al. (1999) who examines the rate of development of cardiac action. The author presents a table that defines the values of the heart rate in children aged 2-10 years, and it is also possible to monitor the lower, the reasonable and the upper limit of the values of cardiac action rate.

A convenient source is represented also by the publication by Trojan et al. (1999) that describes the physiological principles and physiology of individual organs and

systems in human organism, describing complicated biomechanics of the human body. Meško, Komadel et al. (2005) transparently define the domains of sports medicine. They define concepts related to movement activity and potential pathological manifestations during the inappropriate physical activity of the body.

Mužik (1991) pursues the research survey on tracking the changes in heart rates of children during physical education. He shows the results of the survey from 1986-1990 where he utilizes the research method of the time-motion study, supplemented with tracking the changes in the heart rates of pupils. Surveyed results have produced facts about improper use of time in a physical education lesson (lessons with the training times of less than 20 % of the lesson-time have not been exceptions) as well as about the improper intensity of activities with regard to develop general endurance. Based on the obtained results, the author has arrived at criteria for assessment of the teaching process of a Physical Education teacher at the first grade of primary schools. In our research measurement we have utilized the physiological curve of heart rate as given in this publication.

Many authors deal with the method of monitoring the effectiveness of a P. E. lesson. In particular, Mužik (1991) in his work deals with the assessment of educational activity of the teacher. Other authors are Frömel, Novosad and Svozil (1999, p. 71), who identify the need for a comprehensive point of view of motion activity that goes beyond a P. E. lesson.

In research there are also other methods and functional measurement that are most commonly used in the diagnostics of the effectiveness of physical education lessons and for the assessment of pupils capabilities of motion activity. This is for example the method of evaluation of fatigue marks developed by ZOTOV (Hadač and Prášilová, 1982), Ruffier test for the assessment of the fitness condition (Riegerová, Přidalová and Ulbrichová, 2006), the time-motion study (Hadač and Prášilová, 1982), Mužik (1991), and monitoring the intensity of activity by measuring the heart rate in children of younger school age (Mužik, 1991) and (Hurychová and Vilímová, 1997).

The findings from the above mentioned researches can be used as the starting points for the objective of the paper. Since all the studies are directly aimed at school education in practice, we would like to draw attention to the possibility of using the method of comparison of developments in heart rate changes in relation to the lesson directly in the undergraduate preparation of students at faculties oriented to sports and education and thus offer a simple feedback to them, thanks to which we can influence their educational practices.

Methods

From the above mentioned researches on P. E. didactics which touch upon the solved issues we have deduced our research objective: to express the relation of the

heart rate curve development taken from the course of model P. E. lessons and the optimal curve of heart rate in a P. E. lesson (selected on the basis of research findings, research literature search and intended for younger school age) in relation to the content of the teaching attempt of an undergraduate student studying in the Teacher Training at the first grade of primary school study programme.

We establish the null hypothesis as for the examined (available) datasets of physiological curves of heart rate described in the academic literature:

H1: There is no evident difference in the selected physiological curves of the heart rate.

We establish the following null hypothesis as for the examined (two-dimensional) data sets of optimal physiological curve and the development of the heart rate in model P. E. lessons:

H2: There is no relation between the optimal of physiological curve and the development of heart rate in a model P. E. lesson.

The research took place at the Faculty of Education at Masaryk University in Brno and was done in students of the Teacher Training at the first grade of primary school programme specializing in Physical Education, and in particular, within the study courses Didactics of Sport Games and Athletics, and Didactics of Gymnastics. During the course of representation lessons of physical education heart rate measurement was realised by means of a sport tester and the palpation method with the aim to create reference values for our research as well as provide feedback to the teaching students. The first heart rate measurement was performed in zero minute, followed by measurements after each five minutes of educational time.

The main method of empirical research applied in the submitted paper is the monitoring of changes in the heart rate of pupils, which is complemented by the time-motion (measuring the effective work with time in the lesson of physical education). This is a simple method of the medico-pedagogical observation, suitable for detection of physiological effectiveness of exercise and the session time of pupils activity time in physical education lessons (Mužík, 1991; Fialová, 2010).

The nature of the data obtained has resulted in the use of statistical methods, by means of which we proved two main hypotheses and several partial hypotheses.

The validity of the null hypothesis is proved by using the analysis of variance (ANOVA). The significance level α was set at 0.05. The statistical analysis of a two-dimensional data set has been expressed using the correlation coefficient (r_{XY}). Furthermore, we have used the test the independence of two quantitative characteristics, where we assess whether the difference between the correlation coefficient and zero is statistically significant.

Results

Optimal physiological curves of the heart rate in the course of the physical education lesson follow from the studies and experiences of the experts focusing on school physical education.

Physiological curve no. 1 is described by Hurychová and Vilímová (1997, p. 26).

Physiological curve no. 2 is deduced by Frömel (1991, p. 64).

Physiological curve no. 3 is characterized by Mužík (1991, p. 19). He states the heart rate values collected from the introductory part of the lesson, setting-up part of the lesson, training, practice and the final part of the lesson.

The null hypothesis H1 has been adopted for testing the examined (population) datasets of developments of physiological curves of the heart rate as described in the academic literature. Further in the present paper, we follow the physiological curve introduced by Mužík (1991), even though the described physiological curves are similar as for their developments.

On the basis of a statistical test of independence with the test criterion limit ranging from $-2.57 - 2.57$ and based on the resulting absolute values of the correlation coefficient, we have adopted the null hypothesis H2 in 46 research cases as follows:

H2: There is no relation between the optimal physiological curve and the development of heart rate in a model P. E. lesson.

The null hypothesis has been rejected only in two research cases and the alternative hypothesis A has been adopted as follows:

A: There is a relation between the optimal physiological curve and the development of heart rate in a model P. E. lesson.

The results of the statistical survey give evidence that the relation between the HR developments in model P. E. lessons led by students and the optimal physiological HR curve is evident only in two cases.

It is essential to view this issue also from the pedagogical perspective, or to some extent, take into account the results of the research with regard to the specific features of P. E. didactics. The results of our research can be divided into three groups based on the obtained absolute values of the correlation coefficient. Result group no. 1 includes HR developments, for which the statistical test of independence rejected the null hypothesis, i.e. the HR developments, in which the relation between the optimal physiological curve has been proven.

From the pedagogic point of view we could take into account HR developments taken from model P. E. lessons, in which the resulting absolute value of the correlation coefficient was ≥ 0.5 , and hence consider the relation between the HR developments taken from model P. E. lessons and the optimal physiological curve as average. Group

no. 2 includes HR developments taken from model P. E. lessons, in which the absolute values of the correlation coefficient were close to zero, i.e. a really weak relation between the optimal physiological curve. Group no. 3 will include HR developments with the resulting negative absolute values of the correlation coefficient, where we speak about a negative correlation between the HR developments. Negative correlation indicates that together with higher values in one set there have also been higher values in the second data set, though being of negative values. The results of the research included in Group no. 3 shall communicate that the physical activity of the organism in model P. E. lessons has not correspond with the criteria established in the academic publication.

The first group included heart rate developments, in which the statistical test of independence has rejected the null hypothesis, i.e., the heart rate developments, in which the relation between the optimal physiological curve has been demonstrated. It has been the case of heart rate development within a model lesson of Didactics of Volleyball and within a model lesson of Sport Games. Heart rate developments which showed the average relation between the optimal physiological curve, were, as far as possible, taken from the model lessons containing the didactics of floorball, volleyball and athletics. According to the graphic representation of the values of the heart rate during the representation lessons of physical education one can conclude that students have difficulties to effectively manage the setting-up part and the training part of a physical education lesson.

The second group of research results consisted of heart rate developments, in which the resulting absolute values of the correlation coefficient have been close to zero, standing for a very weak relation between the optimal physiological curve and the heart rate developments from representation lessons of physical education managed by the students. This group has comprised the total of 22 heart rate developments and has been the most extensive one with regard to the number of heart rate developments. The majority of heart rate developments have been observed in model lessons containing the didactics of football, athletics and volleyball.

The third group of research results consisted of heart rate developments of students with the resulting negative absolute values of the correlation coefficient. In this group of research results the majority of heart rate developments taken from model lessons containing the didactics of handball and athletics.

Twenty percent of teaching attempts has approached the criteria for the optimal physical activity of the organism in the lesson of physical education as described in the academic literature. Very weak relation in the teaching attempts of students has occurred in 41 % of model lessons. The results of the research have also suggested the information that 39 % of tested heart rate developments from the representation

lessons of physical education does not correspond to the criteria of the optimal physical activity referred to in academic publications. Taking the results into account, we can recommend the use of sport testers throughout representation lessons of physical education so that a continuous feedback is provided as far as the content of the lesson is considered.

Discussion

The research presented in the present paper has been focused on heart rate monitoring in terms of optimal physical activity in physical education lessons. We believe that it is very important that students of physical education do in their undergraduate preparation pay attention to not only the content of sporting, athletic and other disciplines, but also the optimal physical activity during the implementation of these disciplines. For this reason, measurement of the heart rate should become an inherent the Didactics of physical education study course. Future teachers should normally work with sport testers, check the heart rate during physical activities, and subsequently process the measured values on a personal computer. The next step may be the cooperation of the students in form of data evaluation, graphical representation of the heart rate, and comparing the intensity of activity during a concrete lesson realised within the Didactics of Physical Education study course.

Conclusions

We have acquired new knowledge in the area of undergraduate training of future teachers specializing in physical education.

The empirical research part of the paper was based on the examination of the developments of the heart rate that have been measured in representation lessons of physical education realised within the Didactics of Sport Games and Athletics study course. The research target has been to test to what extent the heart rate developments obtained from the representation lessons of physical education managed by students approach criteria described in academic publications.

The research data set consisted of 48 developments of heart rate of students and we have examined the statistically significant relation between the the physiological curve described in the academic literature.

References

- Dylevský, I. Základy funkční anatomie. 1. vyd. Olomouc: Poznání, 2011. 332 s.
- Fialová, L. Aktuální témata didaktiky školní tělesná výchova. 1. vyd. Praha: Karolinum, 2010. 151 s. ISBN 978-80-246-1854-8.
- Frömel, K. Teorie programového učení v tělesné výchově. 1. vyd. Praha: Státní pedagogické nakladatelství, 1991. 302 s. ISBN 80-7067-084-3.
- Frömel, K., Novosad, J., Svozil, Z. Pohybová aktivita a sportovní zájmy mládeže. 1. vyd. Olomouc: Univerzita Palackého v Olomouci, 1999. 173 s. ISBN 80-7067-945-X.
- Hurychová, A., Vilímová, V. Didaktika tělesné výchovy. 1. vyd. Brno: Masarykova univerzita, 1997. 71 s. ISBN 80-210-1525-X.
- Meško, D., Komadel, L. a kol. Telovýchovnělekárske vademecum. 1. vyd. Bratislava: Slovenská spoločnosť telovýchovného lekárstva, 2005. 221 s.
- Mužík, V. Didaktika tělesné výchovy pro 1. stupeň základní školy. 1. vyd. Brno: Masarykova univerzita, 1991. 53 s. ISBN 80-210-0338-3.
- Mužík, V., Krejčí, M. Tělesná výchova a zdraví. 1. vyd. Olomouc: Hanex, 1997. 144 s. ISBN 80-85783-17-7.
- Nováček, V., Mužík, V., Kopřivová, J. Vybrané kapitoly z teorie a didaktiky tělesné výchovy. 1. vyd. Brno: Masarykova univerzita, 2001. 46 s. ISBN 80-210-2642-1.
- Riegerová, J., Přidalová, M., Ulbrichová, M. Aplikace fyzické antropologie v tělesné výchově a sportu. 3. vyd. 262 s. ISBN 80-85783-52-5.
- Rychtecký, A., Fialová, L. Didaktika školní tělesné výchovy. 2. přeprac. vyd. Praha: Karolinum, 2004. 171 s. ISBN 80-7184-659-7.
- Ttojan, S. a kol. Lékařská fyziologie. 3. vyd. Praha: Grada, 1999. 612 s.
- Vilímová, V. Didaktika tělesné výchovy. 2. přeprac. vyd. Brno: Masarykova univerzita, 2009. 144 s. ISBN 978-80-210-4936-9.

**Proceedings of the
9th International Conference
Sport and Quality of Life 2013**

*Brno, Masaryk University Campus, Nov. 7-8, 2013
Organised by the Faculty of Sports Studies*

Editors

*Martin Zvonář
Zuzana Sajdlová*

Reviewers

*Weimo Zhu
Andrew M. Lane
Willy Pieter
Zdenko Reguli
Jana Nová
Vladimír Psalman*

Technical editor

*Michal Huvar
Petr Líznar*

**muni
PRESS**

*Published by Masaryk University, 2013
ISBN 978-80-210-6640-3*

