RELATIONSHIP OF THE RESULTS FROM FITNESS TEST AND POINTS FOR PERFORMANCE IN ALPINE SKIING OF THE CZECH NATIONAL TEAM OF U14 AND U16 CATEGORIES IN THE SEASON 2018/2019

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Jan Jurečka, Tomáš Horáček

Masaryk University; Faculty of Sports Studies; Czech Republic

ABSTRACT

The main motivation for the research is a verification of applicability of the fitness test as a predictor for specific alpine skiing performance of the Czech national team of U14 and U16 categories. We want to verify if the results from the fitness test correspond with points for the performance in alpine skiing disciplines (slalom, giant slalom, super giant slalom). In total, 42 men and women (U14 and U16 categories), members of the Czech national team, participated in the research. Participants were grouped by gender (women n=21, age 14.23 (± 1.04), men n = 21, age 14.19 (± 1.07)). Fitness test consisted of six individual tests and was used as a tool to examine the level of motor abilities (jumping over the Swedish bench, shuttle run 4 × 10m, standing long jump, hurdles agility run - boomerang test, twist test, 20m shuttle run - beep test). Points for the performance in alpine skiing show the best result from a single competition transferred to the points. In our research we were looking for relationship between the points from three different disciplines (slalom, giant slalom, super giant slalom) and the results from the fitness test. In the men category we found high correlation (at the significance level of $p < 0.05$) between super giant slalom and standing long jump ($r = -0.73$; $r^2 = 0.53$), between super giant slalom and boomerang test ($r = 0.62$, $r^2 = 0.38$) and between super giant slalom and shuttle run 4 × 10m ($r = 0.61$, $r^2 = 0.37$). Small correlation was found between slalom and box jump test ($r = -0.31$, $r^2 = 0.1$), between slalom and twist test ($r = -0.33$, $r^2 = 0.11$) and between super giant slalom and twist test ($r = -0.34$, $r^2 = 0.12$). In women category we did not found high correlation (at the significance level of $p < 0.05$). Small correlation was found between slalom and box jump ($r = -0.31$, $r^2 = 0.1$), between giant slalom and twist test ($r = 0.01$, $r^2 = 0.0001$), between super giant slalom and standing long jump ($r = -0.03$, $r^2 = 0.0009$) and between slalom and shuttle run 4 × 10m ($r = -0.05$, $r^2 = 0.0025$). Twist test had very small correlation in both men and women categories. We can say that it is not relevant for prediction of alpine skiing performance. Based on different significance of correlations between men and women (super giant slalom and standing long jump; slalom/super giant slalom and shuttle run 4 × 10m) it might be necessary to adjust fitness testing as a predictor of alpine skiing performance according to a gender.

Keywords: Alpine skiing; Slalom; Giant slalom; Super giant slalom; Fitness test; FIS; FIS points; Points for performance in alpine skiing; Motor abilities

Introduction

To predict performance and to select talented athletes in alpine skiing is a complicated process. Testing fitness in alpine skiing is a part of preparation for alpine skiing performance (Hydren et al., 2013; Vogt, 2013; Mueler et al., 2000). It is crucial to create an adequate battery of fitness tests. Hydren et al. (2013) introduces many different fitness tests which are used for testing of physical abilities in countries such as Canada, USA, Australia, New Zealand and of course European countries participating in alpine skiing competitions. Unified system of physical testing does not exist. Every country uses different fitness tests. The most commonly used tests are as follows: countermovement jump, average of 5 countermovement jumps, 1 repetition squat, V̇O2max, cycling ergometer wattage at 4 mmol of lactate (lactate threshold), lateral box jump test, hex test (Hydren et al., 2013); hurdles agility run (boomerang test), beep test (Gonaus & Müller, 2012); standing long jump (Müller et al., 2015) cooper test, drop jump, bench press (Raschner et al., 2013); twist test, Swiss cross (Vogt, 2013); shuttle run test, pull-ups, push ups, sit ups, zig zag run (Heikkinen, 2003).

Fitness testing serves as a tool to examine aerobic and anaerobic capacity, strength, velocity, endurance and coordination abilities (Raschner et al., 2013). The relationship between results of disciplines of alpine skiing (slalom, giant slalom, super giant slalom) and individual fitness tests is the main subject of our research. Similar topic was examined by Heikkinen (2003), Bogataj et al. (2018), Andersen et al. (1990), Turnbull et al. (2009), Duvillard (1995) or Jasmin et al. (1989). Current results show high correlation between giant slalom and standing long jump, giant slalom and box jump (Andersen et al., 1990; Turnbull et al., 2009). Anaerobic strength correspond more to alpine skiing performance than aerobic strength (Duvillard, 1995). High correlation was also found between alpine skiing performance and combination of four fitness tests (run from the flying start, ten jumps on both legs, 400m run, counter-movement jump, $r = 0.73$, $r^2 = 0.53$) (Bogataj et al., 2018). Heikkinen (2003) found high correlation between slalom/giant slalom and zig zag run ($r = 0.77$; $r^2 = 0.6$/ $r = 0.71$; $r^2 = 0.5$), between slalom/giant slalom and hexagonal jump ($r = 0.58$; $r^2 = 0.34$/$r = 0.69$; $r^2 = 0.45$) and between slalom/giant slalom and box jump ($r = -0.6$; $r^2 = 0.36$/$r = -0.67$; $r^2 = 0.45$). Similar high correlation between hexagonal jump and giant slalom ($r = 0.82$; $r^2 = 0.67$) and between slalom and box jump ($r = -0.8$; $r^2 = 0.64$) was also found by Andersen et al. (1990). Correlation of alpine skiing performance and results of hexagonal jump varies among authors. Heikkinen (2003) and Andersen et al. (1990) found high correlation. Jasmin et al. (1989) did not find high correlation. Heikkinen (2003) found very small correlation between sit-ups in 60 seconds and alpine skiing performance ($r = -0.05$; $r^2 = 0.0025$).

The aim of our research is to find relationship between the chosen fitness tests and points for performance in alpine skiing disciplines (slalom (SL), giant slalom (GS), super giant slalom SG)). We will also make a correlation between individual fitness tests. The results will be compared to the results of other authors. Based on the results some of the tests might be eliminated or replaced by more appropriate fitness tests.

Methods

- ***Participants***

For our research we selected intentionally members of the Czech junior representation team in alpine skiing. Number of participants n=42 (women n=21, age 14.23 (± 1.04); men n=21, age 14.19 (± 1.07)). Fitness test took place at the beginning of first preparatory period in 2019. Fitness test consisted of these individual tests: Shuttle run 4x10m, standing long jump, hurdles agility run - boomerang test, twist test, jumping over the Swedish bench and 20 meter shuttle run - beep test.

- ***Procedure***: description of fitness tests:

Shuttle run 4 × 10m

Procedure of the shuttle run 4 × 10m is described by Ramírez-Vélez et al. (2015). We measured two tries with accuracy of 0.1s. Better try counts.

Standing long jump
Procedure of the standing long jump is described by Müller et al. (2015). We measured two tries with accuracy of 1cm. Better result counts.

Hurdles agility run – Boomerang test
Procedure of the hurdles agility run is described by Gonaus & Müller (2012). We measured two tries with accuracy of 0.1s. Each run started to opposite direction. Both runs counts together.

Twist test
Procedure of the twist test including incorrect execution is described by Vogt (2013). Test takes 60s. Only correct repetitions counts.

Jumping over the Swedish bench
Participant is jumping over the up side down Swedish bench for 45s. Number of jumps counts.

20 meter shuttle run – Beep test
Procedure of the 20 meter shuttle run - Beep test is described by Heikkinen (2003). The results are set according the evaluating table. Time and distance counts.

All fitness tests had been done within one day in the order shown above. Before the testing day intensity of the training had been reduced. There was enough time for a rest between tests. Before the final endurance test (beep test) there was a 30 minute break.

The results from individual fitness tests correlated with points for performance in alpine skiing disciplines (SL, GS, SG). Points for performance were retrieved from 9th list of points from junior alpine skiers in season 2018/2019.

Points for performance in alpine skiing are counted as described below:
$P = (Tx/To - 1) \times F$
P – points for performance in alpine skiing
Tx – time of a racer in seconds
To – time of a winner in seconds
F – constant for individual disciplines

Constant F is counted before the racing period for equalization of different disciplines.
Constant F for the season 2018/2019:
SL = 730. GS = 1010. SG = 1190.

Penalty points set the quality of particular race and are counted as described in guidelines for season 2018/2019 published by Czech ski association (SLČR OSÚ AD, 2018)

In our research we could either use one best result transferred in points counted together with the penalty points in each discipline or mean value from two best results transferred to points without penalty points. We decided for the second option.

- ***Statistical analysis***

All data were processed by software Statistica 13.2. Based on Kolmogorov – Smirnov test the data does not come from normal distribution. For setting the correlations (r) we used Spearman Rank Order Correlations (r = 0–0.1 = very small correlation; 0.1–0.3 = small correlation; 0.3–0.5 = medium correlation; 0.5–0.7 = high correlation; 0.7–0.9 = very high correlation; 0.9–1 = perfect correlation). We also mentioned the Effect size (r^2), which represents quantitative measure of the magnitude of phenomenon (r^2 = 0.1 = small; 0.3 = medium; 0.5 = large). Some correlations might be negative. It is due to a fact that better results in alpine skiing equal lower points for performance.

Results

In the tab. No. 1 and tab. No. 2 there are men´s, resp. women´s results from individual fitness tests. In the tab. No. 3 and tab. No. 4 there are correlations between men´s, resp. women´s individual fitness tests and points for performance in individual disciplines of alpine skiing.

In men´s category high correlation was found between SG and standing long jump ($r = -0.73$; $r^2 = 0.53$), between SG and hurdles agility test ($r = 0.62$, $r^2 = 0.38$) and between SG and shuttle run 4x10m ($r = 0.61$, $r^2 = 0.37$). Medium correlation was found between SG and twist test ($r = -0.34$, $r^2 = 0.12$), between SL and twist test ($r = -0.33$, $r^2 = 0.11$) and between SL and jumping over the Swedish bench ($r = -0.31$, $r^2 = 0.1$). In women´s category no high correlation was not found. Medium correlation was found between SL and jumping over the Swedish bench ($r = -0.31$, $r^2 = 0.1$). Very small correlation was found between SL and shuttle run 4 × 10m ($r = -0.05$, $r^2 = 0.0025$), between SG and standing long jump ($r = -0.03$, $r^2 = 0.0009$) and between GS and twist test ($r = 0.01$, $r^2 = 0.0001$).
Correlation is significant at the level $p < 0.05$.

In the tab. No. 5 correlation between men´s individual fitness tests can be seen. High correlation was found between Shuttle run 4x10m and standing long jump ($r = 0.67$, $r^2 = 0.45$) and between hurdles agility test and 20m shuttle run ($r = 0.62$, $r^2 = 0.38$). In the tab No. 6 there is correlation between women´s individual fitness tests. Very high correlation was found between 20m shuttle run and twist test ($r = 0.71$, $r^2 = 0.5$).
Correlation is significant at the level $p < 0.05$.

Table 1 *Results from the fitness test men*

Variable	Mean	Minimum	Maximum	Std. Dev.
Shuttle run 4 × 10m (s)	10,595	9,650	11,210	0,4154
Standing long jump (cm)	227,810	180,000	277,000	26,0127
Boomerang test (s)	24,510	22,160	27,160	1,4541
Twist test (n)	122,571	94,000	140,000	11,4262
Swedish bench jump (n)	86,381	60,000	104,000	9,7646
Beep test (m)	1818,095	1080,000	2460,000	339,5235

Table 2 *Results from the fitness test women*

Variable	Mean	Minimum	Maximum	Std. Dev.
Shuttle run 4 × 10m (s)	11,064	10,3900	11,710	0,4305
Standing long jump (cm)	214,238	185,0000	238,000	15,8868
Boomerang test (s)	25,909	23,5400	28,380	1,3540
Twist test (n)	112,286	93,0000	133,000	11,3408
Swedish bench jump (n)	84,524	62,0000	120,000	12,4363
Beep test (m)	1495,238	900,0000	2100,000	340,0532

Table 3 *Fitness test and race points men*

Variable	SL (p)	GS (p)	SG (p)
Shuttle run 4 × 10m (s)	-0,055213	-0,140955	-0,272166
Standing long jump (cm)	0,118908	0,101365	-0,038337
Boomerang test (s)	-0,154545	-0,110390	-0,214286
Twist test (n)	-0,095641	0,013012	-0,091737
Swedish bench jump (n)	-0,315963	-0,167428	-0,206516
Beep test (m)	-0,251462	-0,149448	-0,041585

Table 4 *Fitness test and race points women*

Variable	SL (p)	GS (p)	SG (p)
Shuttle run 4 × 10m (s)	0,562520	0,491718	0,614485
Standing long jump (cm)	-0,503251	-0,457738	-0,736021
Boomerang test (s)	0,577922	0,610390	0,627273
Twist test (n)	-0,339083	-0,602670	-0,342988
Swedish bench jump (n)	-0,312948	-0,546520	-0,520495
Beep test (m)	-0,506357	-0,566312	-0,517436

Table 5 *Correlation between individual tests from the fitness test men*

Variable	Shuttle run (s)	Standing long jump (cm)	Boomerang test (s)	Twist test (n)	Swedish bench jump (n)	Beep test (m)
Shuttle run 4 × 10m (s)	1,000000	-0,665366	0,583956	-0,255534	-0,399935	-0,573667
Standing long jump (cm)	-0,665366	1,000000	-0,436931	0,369502	0,548534	0,293639
Boomerang test (s)	0,583956	-0,436931	1,000000	-0,204361	-0,379311	-0,616491
Twist test (n)	-0,255534	0,369502	-0,204361	1,000000	0,499837	0,349772
Swedish bench jump (n)	-0,399935	0,548534	-0,379311	0,499837	1,000000	0,444336
Beep test (m)	-0,573667	0,293639	-0,616491	0,349772	0,444336	1,000000

Table 6 *Correlation between individual tests from the fitness test women*

Variable	Shuttle run (s)	Standing long jump (cm)	Boomerang test (s)	Twist test (n)	Swedish bench jump (n)	Beep test (m)
Shuttle run 4 × 10m (s)	1,000000	-0,125772	0,352712	-0,113245	-0,305312	-0,248294
Standing long jump (cm)	-0,125772	1,000000	-0,386615	0,057617	0,555739	0,083875
Boomerang test (s)	0,352712	-0,386615	1,000000	-0,084581	-0,296419	-0,447693
Twist test (n)	-0,113245	0,057617	-0,084581	1,000000	0,303525	0,708008
Swedish bench jump (n)	-0,305312	0,555739	-0,296419	0,303525	1,000000	0,408085
Beep test (m)	-0,248294	0,083875	-0,447693	0,708008	0,408085	1,000000

Discussion

Based on the results we can see very small correlations between alpine skiing disciplines and the twist test. Similar results were also found by Heikkinen (2003) with very small correlation between results from alpine skiing disciplines and sit-ups for one minute ($r = -0.05$; $r^2 = 0.0025$).

As a result of correlation between the twist test and the beep test in women´s category ($r = 0.71$, $r^2 = 0.5$) together with very small correlation between alpine skiing performance and the twist test we can say that the twist test is not useful for prediction of alpine skiing performance and can be replaced by the beep test.

We found different significance of correlations between men´s and women´s categories. In particular the different correlation between GS and standing long jump; SL/SG and shuttle run 4 × 10m. The different significance of correlations between alpine skiing performance and results from fitness testing at men´s and women´s categories were found also by Heikkinen (2003). In the research from Šuc et al. (2018) high correlation was found between alpine skiing performance and learning of new gymnastic figures in men´s category but very small correlation in women´s category. It might be useful to adjust fitness testing according to a gender of skiers for more accurate prediction of the alpine skiing performance.

Conclusion

Alpine skiing performance correlate the most with results of those fitness tests: standing long jump, boomerang test and shuttle run 4x10m. Very small correlation was found between alpine skiing performance and the twist test. Higher correlations were found in men´s categories. This difference between men and women might be caused by different development of motor skills at a certain age. Current results of our research consist of correlations between alpine skiing performance in the season 2018/2019 and results of only one measurement of the fitness of skiers. In the future we would like to repeat the fitness testing and verify it´s usability as a tool for prediction of an alpine skier´s performance and also for selection of skiers to the national alpine skiing team.

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