THE EFFECT OF CLASSICAL BALLET, SLOVAKIAN FOLKLORE DANCE AND SPORT DANCE ON STATIC POSTURAL CONTROL IN FEMALE AND MALE DANCERS

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ABSTRACT

Purpose: Classical ballet, Slovakian folklore dance, and sport dance training differ in their way how to master the art of dance; however, postural control is essential for the correct execution of complex movements used in all types of dance. The aim of this study was to analyse the differences in static postural control between classical ballet dancers, Slovakian folklore dancers and sport dancers and to analyse the effect of body mass, body height and toe grip strength on postural control.
Methods: 68 dancers, between 17 to 28 years of age, participated in this study: 21 dancers from Slovakian folklore dance group VSLPT Poľana Brno (12 females, 9 males), 22 dancers from Brno Dance conservatory (16 females, 6 males) and 25 sport dancers competing at Brno Dance Open 2019 (12 females, 13 males). All participants were asked to stand upright, barefooted, arms along the body, both feet on the Emed-at platform (Novel GmbH, Germany) for 10 seconds with their eyes open to obtain the length of COP line (cm), average velocity of COP (cm/s), the elliptic area (mm^2) and numerical eccentricity of the ellipse. The toe grip strength was measured for each foot when sitting using toe grip dynamometer (Takei Scientific Instruments, Niigata, Japan). To analyse the effect of dance style, to grip strength, body mass, body height, and gender on postural control variables, Kruskal Wallis test, and Spearman Rank Order Correlation were used.
Results: A better postural stability measured by the length and average velocity of COP was observed in sport dancers, compared to classical ballet and Slovakian folklore dancers. Sport dancers are used to a greater load on the forefoot and to a special foot roll-of pattern when dancing, which may lead together with a constantly changing environment during competitions to their enhanced postural stability. Despite the differences in dance training and dance footwear of female and male dancers (high-heel shoes in sport and Slovakian folklore female dancers, pointe shoes in female ballet dancers), no statistically significant difference in postural variables between genders was observed. Similarly, in analysed dancers, no effect of age, body mass, and body weight on postural control were observed. The toe grip strength was not observed to affect the postural variables in this study. The greatest toe grip strength was observed in female ballet dancers, despite their younger age. Ballet dance training includes repetitive exercises focused on foot and toes such as *battement tendu* or *demi-pointe* and *en pointe* positions probably resulting in the greater strength of the toes.
Conclusion: In this study, better postural stability measured by the length and average velocity of COP was observed in sport dancers, compared to classical ballet and Slovakian folklore dancers. In analysed dancers, no effect of body mass, body weight, gender, and toe grip strength on postural control variables was observed. Future studies focused on postural stability changes in non-dancers after a sport dance, classical ballet and Slovakian folklore dance training program would provide additional knowledge about the process how each type of dance enhance the balance and other coordinative skills.

Keywords: postural stability; dance; length of COP; the average velocity of COP; toe grip strength

Introduction

Dancers have enhanced balance skills (Gerbino, Griffin & Zurakowski, 2007; da Silveira Costa, de Sá Ferreira & Ramiro Felicio, 2013). However, different types of dance such as ballet, Slovakian folklore dance, and sport dance differ in their demands put on the dancer, which may result in different balance control. Balance, or static postural control, minimize the centre of gravity displacement during quiet standing (Perrin, Deviterne, Hugel & Perrot, 2002). The postural control is affected by the somatosensory, visual, and vestibular system, joint range of motion, and strength (Ricotti, 2011). Furthermore, the previous study shows that postural stability is also affected by body mass and gender (Ku, Abu Osman, Yusof & Wan Abas, 2012).

Classical ballet dancing involves both static balance and dynamic choreographic figures for which the balance control is essential as the female dancers dance *en pointe* using the pointe shoes. Additionally, ballet consists of extreme ranges of motion, especially seen in the ankle plantar flexion and hip extension. On the other hand, ballet dancers perform in a stable environment on a stage or in front of a mirror where no unexpected disturbances occur (Perrin et al., 2002; Lin, Lee, Liao, Wu & Su, 2011; Hugel, Cadopi, Kohler & Perrin, 1999).

Slovakian folklore dance is a part of the Central and Eastern European dancing folklore, has been formed since the 5th century and influenced during the period of the Austria-Hungarian Empire by different ethnic groups (Matúš, 2016). Slovakian dance folklore includes *chorovody* and *kolesá (karičky),* girls' round dances, in 2/4 and 4/4 time, characterized by a slow, resting part and a faster part with more difficult steps turning the circle in increased tempo. Men's dance includes *odzemok* and *verbunk* characterized by jumps and squats. Couple turning dances, *krútivé tance*, usually consist of four parts: the man singing to the musicians the song he wants to play, man solo dance, couple dance when man and women turn as a pair, and man and women separate dance. Čardáš, a Hungarian couple turning dance, is also one of the Slovakian couple turning dances (Giertlová, 2014).

Sport Dance express emotions provoked by a different type of music of ballroom or Latin-American dances (Lukić, Bijelić, Zagorc & Zuhrić-Šebić, 2011). During the competition, sport dancers pairs present their program at a simultaneous presentation in a constantly changing environment in which they must anticipate the movement of other competitors and preserve the space for their own presentation (Kuczyński, Szymańska & Bieć, 2011).

The classical ballet, Slovakian folklore dance, and sport dance training differ in their way how to master the art of dance; however, postural control is essential for the correct execution of complex movements used in all types of dance and also serves as a protection against injuries (Ricotti, 2011). The aim of this study was (i) to analyse the differences in static postural control between classical ballet dancers, Slovakian folklore dancers and sport dancers; (ii) to analyse the effect of gender, age, body mass and body height on postural control; and (iii) to analyse the effect of toe grip strength on postural control.

Methods

68 dancers, between 17 to 28 years of age, participated in this study: 21 dancers from Slovakian folklore dance group VSLPT Poľana Brno (12 females, 9 males), 22 dancers from Brno Dance conservatory (16 females, 6 males) and 25 sport dancers competing at Brno Dance Open 2019 (12 females, 13 males). Their body mass, body height, and age are shown in Table 1. Informed consent was provided by all participants or their caregivers prior to the data collection.

Table 1 *Dancers characteristic: age (years), body mass (kg), and body height (cm)*

		n	Age	Body mass	Body height
Slovakian folklore dance	female	12	22,58 ± 2,47	55,73 ± 7,28	167,07 ± 6,34
	male	9	22,44 ± 1,67	74,43 ± 8,93	179,89 ± 1,67
Classical ballet	female	16	18,06 ± 1,00	54,83 ± 5,96	166,69 ± 5,46
	male	6	18,00 ± 1,26	64,13 ± 6,68	172,92 ± 6,48
Dance sport	female	12	20,33 ± 2,67	56,47 ± 6,76	164,63 ± 5,02
	male	13	20,69 ± 2,87	69,93 ± 9,04	179,52 ± 7,64

All participants were asked to stand upright, barefooted, arms along the body, both feet on the Emed-at platform (Novel GmbH, Germany) for 10 seconds with their eyes open, looking straight ahead to obtain the length of COP line (cm), average velocity of COP (cm/s), the elliptic area (mm^2) and numerical eccentricity of the ellipse. The toe grip strength was measured twice for each foot when sitting using a toe grip dynamometer (Takei Scientific Instruments, Niigata, Japan), and the higher value was used for further analysis.

To analyse the effect of dance style on postural control variables, the Kruskal Wallis test was used. The correlation between to grip strength, age, body mass, body height, postural control variables, and dance style was analysed by Spearman Rank Order Correlation. Additionally, the gender differences in postural variables were analysed using an unpaired t-test.

Results

The mean toe grip strength (N), length of COP line (cm), the average velocity of COP (cm/s), elliptic area (mm^2) and numerical eccentricity are shown in Table 2.

Table 2 *Mean toe grip strength (kg), length of COP line (cm), the average velocity of COP (cm/s), elliptic area (mm^2) and numerical eccentricity of female and male Slovakian folklore, classical ballet and sport dancers*

		Toe grip strength		Length of COP	Average velocity of COP	Elliptic area	Numerical eccentricity
		Dominant	Non -dominant				
Slovakian folklore dance	**female**	19,27 ± 4,24	20,09 ± 5,67	35,12 ± 7,42	3,58 ± 0,68	155,36 ± 129,50	76,37 ± 20,72
	male	29,97 ± 9,51	30,73 ± 11,35	38,26 ± 11,65	3,82 ± 1,17	326,37 ± 353,80	80,29 ± 18,28
Classical ballet	**female**	27,48 ± 5,76	25,54 ± 5,53	33,74 ± 7,68	3,38 ± 0,77	161,62 ± 239,10	79,02 ± 12,36
	male	29,67 ± 5,78	29,92 ± 7,36	35,37 ± 4,64	3,54 ± 0,47	114,93 ± 91,37	83,79 ± 7,97
Dance sport	**female**	23,93 ± 8,68	24,36 ± 7,37	31,20 ± 4,36	3,12 ± 0,44	184,12 ± 92,36	81,82 ± 7,81
	male	31,51 ± 6,88	31,11 ± 6,25	32,34 ± 4,26	3,24 ± 0,43	176,67 ± 102,22	80,92 ± 13,46

Classical ballet, Slovakian folklore, and sport dancers differences

Results of Kruskal Wallis test show no statistically significant difference between classical ballet, sport dance and Slovakian folklore dance in the length of COP ($p = 0,085$), the average velocity of COP ($p = 0,055$), elliptic area ($p = 0,041$), nor the numerical eccentricity ($p = 0,900$).

The Spearman Rank Order Correlation showed a small correlation between the dance type and toe grip strength (0,239 and 0,231 for dominant and non-dominant foot, respectively), length of COP

(-0,266) and average velocity (-0,298), showing increased to grip strength and decreased length of COP and average velocity of COP in sport dancers compared to classical ballet dancers or Slovakian folklore dancers.

Additionally, the Spearman Rank Order Correlation showed a large correlation between length of COP and average velocity of COP (0,986), a medium correlation between length of COP and numerical eccentricity (0,410), average velocity and numerical eccentricity (0,390) and a small correlation between length of COP and elliptic area (0,281) and average velocity and elliptic area (0,276).

The effect of gender, age, body mass and body height on postural control

Results of Spearman Rank Order Correlation show no effect of age on toe grip strength or postural variables. The effect of gender was observed only in toe grip strength of dominant and non-dominant foot (0,419 and 0,432, respectively), body height (0,661) and body mass (0,674). Similarly, unpaired t-test showed no statistically significant gender differences in postural variables. Body mass showed a statistically significant correlation with toe grip strength (0,415 and 0,422 for dominant and non-dominant foot, respectively), gender, and body height (0,765). Body height was observed to correlate with body mass, age, gender, and toe grip strength (0,462 and 0,425 for dominant and non-dominant foot, respectively).

The effect of toe grip strength on postural control

The results of Spearman Rank Order Correlation show a large correlation between dominant and non-dominant foot toe grip strength (0,807), medium correlation between toe grip strength and gender (0,419 and 0,432 for dominant and non-dominant foot, respectively), body height (0,462 and 0,425 for dominant and non-dominant foot, respectively) and body mass (0,415 and 0,422 for dominant and non-dominant foot, respectively) and a small correlation with dance type (0,239 and 0,231 for dominant and non-dominant foot, respectively).

Discussion

The purpose of this study was to analyse the differences in static postural control between classical ballet dancers, Slovakian folklore dancers, and sport dancers and to analyse the effect of age, body mass, body height and toe grip strength on postural control variables.

In this study, a large correlation between the length of COP and average velocity of COP was observed as the velocity is a division of the length of COP by trial time. In previous studies, the average velocity of COP was observed to be a postural control variable with the greatest reliability when a smaller velocity indicates better postural control (Paillard & Noé, 2015; Jančová Všetečková & Drey, 2013; Prieto, Myklebust, Hoffmann, Lovett & Myklebust, 1996). A medium correlation was observed between the length and average velocity of COP and numerical eccentricity of the ellipse in this study. The numerical eccentricity describes the shape of the ellipse when “0” is a perfect circle, “100” is an elongated, narrow ellipse. The elliptic area quantifies the 95% of the area covered by medio-lateral and anterior-posterior excursions of COP. Similarly to the length and average velocity of COP, the smaller is the elliptic area, the better postural control, and a small correlation between the elliptic area and the length and average velocity of COP was observed in this study (Paillard & Noé, 2015).

The results of this study showed a smaller length and average velocity of COP in sport dancers, compared to classical ballet and Slovakian folklore dancers. Sport dancers are used to a greater load on the forefoot and to a special foot roll-of pattern when dancing, which may lead together with a constantly changing environment during competitions to the enhanced postural stability. Previous studies show better postural control in dancers compared to other athletes or control groups (Gerbino et al., 2007; da Silveira Costa et al., 2013). However, no previous study focused on postural stability in different types of dance is known to the authors.

Despite the differences in dance training and dance footwear of female and male dancers (high-heel shoes in sport and Slovakian folklore female dancers, pointe shoes in female ballet dancers), no statistically significant difference in postural variables between genders was observed. Similarly, no effect of body mass, body height and age on postural variables was observed in this study and was probably caused by the similar body shape characteristics of all dancers as in the general population, the effect of body mass and gender on postural stability was described (Greve, Alonso, Bordini & Camanho, 2007; Hue et al., 2007; Lee & Lin, 2007).

The toe grip strength was not observed to affect the postural variables in this study. An interesting observation was made in female dancers when female sport dancers and Slovakian folklore dancers were observed to have a greater strength in a non-dominant foot (left in most of the dancers), which may be a result of the asymmetrical use of the left and right leg in sport and Slovakian folklore dance. The greatest toe grip strength was observed in female ballet dancers, despite their younger age, who performed better with their dominant foot. Previous study focused on ballet dancers found no statically significant difference in balance when landing from ballet jumps between the self-described stronger and weaker leg (Mertz & Docherty, 2012) as ballet dancers practice symmetrically demanding repetitive exercises focused on foot and toes work such as *battement tendu* or *demi-pointe* and *en pointe* positions (Nihal et al., 2002).

In dancing, most of the injuries are caused by overuse and not by trauma as the movement is choreographed (Gerbino et al., 2007; Teitz, 2000). Previous studies show that lower postural stability increases the risk of injury and can be improved by a special exercise program (Witchalls, Blanch, Waddington, & Adams, 2012; Struhár & Dovrtělová, 2014). Future studies focused on postural stability changes in non-dancers after a sport dance, classical ballet and Slovakian folklore dance training program would provide additional knowledge about the process how each type of dance enhance the balance and other coordinative skills.

Conclusions

This study, focused on postural stability and toe grip strength in dancers, show better postural stability measured by the length and average velocity of COP in sport dancers, compared to classical ballet and Slovakian folklore dancers. In analysed dancers, no effect of age, body mass, body weight, or gender on postural control was observed. Similarly, the toe grip strength was not observed to affect the postural variables in this study, probably because of the enhanced postural stability skills in all three analysed types of dance.

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