DYSMORPHIC DIFFERENCES IN THE DISTRIBUTION OF ADIPOSE TISSUE AMONG COMPETITIVE BALLROOM DANCERS

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Abstract

In competitive ballroom dancing, the assessment of the aesthetics of physique directly affects the result. Although the regulations do not specify any restrictions, judges discriminate against couples with large morphological disproportions. Therefore, physique is an important determinant of selection in this discipline. The varied individual and intersexual dynamics of biological development necessitates a change of a partner during the adolescence period, as the disproportions that arise from therein disturb the fluidity of movements and aesthetics, which is subject to judges' assessment. This paper attempts to estimate the dimorphic differences in the distribution of adipose tissue in a group of male and female dancers practicing competitive ballroom dance at the highest level. The obtained results allow concluding that systematic, multi-annual, task-oriented physical activity of dancers eliminates sex differences in the scope of adipose tissue. Most importantly, the obtained data may be helpful in the development and optimization of selection systems of dance partners for couples practicing competitive ballroom dancing.

Keywords*: ballroom dancers, dysmorphic differences in the distribution of adipose tissue, competitive dancers*

Introduction

In ballroom dancing, physique is an important selection determinant, both when practicing this sport and choosing a dance partner. The judge's assessment is affected by many factors, such as: bar and rhythm, technique, course of movement, body lines, dance character, choreography, and artistic impression. There can also be distinguished general indicators: dance quality - constituting 60%, and dance reception - constituting 40% (Starosta 2003, Sakowska 1999) of the assessment. Thus, the assessment of the aesthetics of physique directly affects the result. This is an important determinant of success at dance tournaments. Although the regulations do not specify any restrictions, judges discriminate against dance couples with large morphological disproportions, although their coordination capacity and technical level is at a similar level. Therefore, there are understandably situations where, despite a rigorous diet, dancers are worried about their fat deposit. This applies to both women and men who practice aesthetic sports (Ferrand et al. 2007, de Bruin et al. 2007, Krentz&Warschburger 2011, Durme et al. 2012, Robbeson et al. 2015, Banio 2018).

The research conducted by other authors shows that athletes, in comparison to control groups of the same age and sex, are less obese and more muscular (McDougall et al. 1991, Mokha et al. 1997, Pieter et al. 2006, Swami 2009). As far as women are concerned, greater adipose tissue in total body mass is found both among athletes as well as people who do not exercise. Nevertheless, the gender differences are significantly lower in the case of people practicing sports. Among those who do not do sports, up to twice as much fat deposit is observed in women than in men (Trzaskoma 2006). These disproportions appear as early as during puberty. In the case of boys, the level of adipose tissue decreases, while the level of muscle mass increases significantly. Whereas in the case of girls, both of these components increase at the same time. This is due to the different metabolic activity of adipose and muscle tissues in both sexes. On average, the amount of subcutaneous adipose tissue in the total body weight of women who are not professional athletes is about 24-28%, whereas in the case of men it amounts to 15-18% (Malinowski 1980). In the case of female athletes, this percentage may even amount to less than 10% (Greydanus&Patel 2002).

This paper attempts to estimate the dimorphic differences in the distribution of adipose tissue in a

group of male and female dancers practicing competitive ballroom dance at the highest level. The obtained data may be helpful in the development and optimization of selection systems of dance partners for couples practicing competitive ballroom dancing.

Materials and methods

The research material consisted of 142 dancers (71 European couples) belonging to the age categories: youth (16-18 years old), under 21 (16-21 years old) and adult (21 years and older), of the highest dance classes A and S, practicing ballroom dancing in European countries, i.e.: Poland, Italy, Great Britain, Germany and Ukraine. The examined women were between 16 and 38 years old ($\acute{x}$ 22 years old), and men between 16 and 39 years old ($\acute{x}$ 24 years old). The dance experience of these couples ranged from 6 to 24 years (women – $\acute{x}$14 years, and men – $\acute{x}$15 years). Couples trained from 5 to 7 days a week (about 10-28 hours). The research regarded couples who trained standard, Latin-American dance and a combination of 10 dances. The research was carried out once. All competitors were informed about the possibility of resigning at any time without any consequences, as well as on the use of results. The research program received a positive opinion of the Bioethical Commission of the Regional Medical Chamber in Szczecin (Resolution No. 17/KB/IV/2012).

The following morphological features were selected for the analysis: body height, body mass, waist and hip circumferences, pelvis and shoulder widths, adipose and muscle tissue in the body. Measurements were made in accordance with the rules applicable in anthropometry (Drozdowski 1998). Body composition measurements were obtained using an analytical balance with an accuracy of 0.1 kg. In order to determine the degree of leanness and obesity, the Quetelet II index (BMI), which reflects the ratio of body mass in kilograms to body height in square meters, was calculated. To determine the distribution of fat deposit, which allows distinguishing the android and *gynoid* type, the index of WHR fat type was calculated, i.e. the ratio of waist circumference in centimetres to hip circumference in centimetres. In order to assign the type of physique in accordance with Kretschmer's classification, the ratio of pelvis width in centimetres to shoulder width in centimetres was calculated, and on this basis, the pelvis-shoulder index was measured. To specify the typological affiliation, the *Rohrer* index, which is the ratio of body mass in grams to body height in cubic centimetres, was used and then multiplied by 100. The body types following the Sheldon system were also determined by calculating the index of slenderness (WS), which determines the ratio of body height in centimetres to the cubic root of body mass in kilograms. To determine the dimorphic differences in the scope of somatic features analysed, the so-called indicator of dimorphism based on the original Mollison method (WD) (Stęślicka et al. 1988, Jopkiewicz & Stuliga 2011) was applied.

The collected material has been subjected to statistical analysis. The results of individual analyses are presented in tables and figures. In the analysis of the strength of correlations, the following scale was adopted: 0 - variables are not correlated; 0 <0.20 – weak correlation (practically no dependence); 0.20 = <0.40 – low correlation (explicit dependence); 0.40 = <0.60 – moderate correlation (significant dependence); 0.60 = <0.80 – high correlation (considerable dependence); 0.80 = <0.90 - very high correlation (very high dependence); 0.90 = <1.00 – almost full correlation.

Research results and discussion

The analysis of the degree of leanness and obesity shows that the majority of male and female competitors fell within the normal variability of this trait. A small percentage of the respondents were classified as underweight, whereas overweight respondents were not observed – which is not surprising due to the specificity of the discipline. The average difference within the couples was only 1.47. The average value of the difference of the Quetelet II index for all competitors forming individual dance couples was 1.47 $\frac{kg}{m^2}$. The lowest value among the differences noted was 2.9 $\frac{kg}{m^2}$ with the dominance of the female partner in a given couple, while the highest was 5.9 $\frac{kg}{m^2}$ with the dominance of the male partner (table 1).

In the case of women, adipose tissue is most often accumulated below the waist (hips, buttocks, thighs), while in the case of men – mainly in the abdomen. Hormones, enzymes and hormone receptors, the location of which favours the deposition of fat in a given area, play an important role here (Roberts&Roberts 1997, Blaak 2001). By analysing the distribution of adipose tissue in the surveyed dancers, it can be concluded that gynoid fat was predominant in both sexes. This means that men have a tendency towards a more "feminine" type of body fat deposit. In the case of male dancers, the android distribution of body fat, typical of men, turned out to be rare (table 1). This was probably a consequence of sports training, as well as the nature of the discipline and lifestyle associated with it. This is also confirmed by the research of other authors (Moehr 1982, Beyer 2002, Mikhailov & Raschka 2010) who observed the distribution of subcutaneous adipose tissue in male dancers, based on skinfold measurements.

When analysing the distribution of the slenderness index, it was noted that all respondents were characterized by ectomorph, i.e. the dominance of tissue originating from ectoderm, and hence a

slender physique (table 1). To verify this, a classification according to the Kretschmer typology was adopted. The formula given by Curtius was used (Drozdowski 1998). The interpretation of the data led to the conclusion that the leptosomatic type of physique dominated both among male and female dancers. Although there were more athletic types of physique among women, the average value of the difference of this indicator for all dancers forming individual couples was 0.01 $\frac{g}{cm^3}$. However, the analysis of the pelvis-shoulder index parameters shows that the average value of the difference for all partners was 0.10. The lowest value among the differences recorded is 0.1, with the male partner's dominance in a given couple, while the highest is 0.5 with the female partner's dominance (table 1).

Table 1. Values of descriptive statistics for measurements of surveyed indicators

Variable	sex	N	$\acute{x}$	SD	Min	Max
Quetelet index ($\frac{kg}{m^2}$)	♂	71	21.60	1.382	17.5	24.9
	♀	71	20.13	1.509	17.1	23.2
	☼	142	1.47	2.030	2.9♀	5.9
Waist to hip ratio	♂	71	0.74	0.094	0.7	1.2
	♀	71	0.68	0.046	0.6	0.9
	☼	142	0.07	0.121	0.1♀	0.5
Index of slenderness ($\frac{cm}{kg}$)	♂	71	44.85	1.196	43.0	48.0
	♀	71	45.00	1.170	43.7	45.9
	☼	142	0.15♀	1.458	2.7	3.5♀
Rohrer's Index of a partner ($\frac{g}{cm^3}$)	♂	71	1.23	0.103	1.0	1.5
	♀	71	1.25	0.097	1.0	1.5
	☼	142	0.01	0.125	0.2♀	0.3
Pelvis-shoulder index (cm)	♂	71	0.74	0.053	0.6	0.9
	♀	71	0.84	0.143	0.7	1.4
	☼	142	0.10♀	0.127	0.1	0.5♀

Explanation: ♂ - size of the partner's attribute ♀ - size of the partner's attribute ☼ - average difference between the partners

When comparing the results of Spearman's correlation with the somatic structure parameters examined, a positive correlation was found for the pelvis-shoulder index ($p < 0.01$), pelvis width ($p < 0.05$) and body height ($p < 0.01$). No correlation between the partners' physique was observed among other parameters (table 2).

Table 2. Correlation of analysed parameters of physique of the subjects

Physique	**R**	**p**
Body weight	0.20	0.198
Adipose tissue	0.07	0.657
Muscle tissue	0.006	0.968
Body height	0.44	0.002**
Waist circumference	0.20	0.189
Hip circumference	-0.10	0.509
Pelvis width	0.30	0.045*
Shoulder width	0.07	0.660
Quetelet II index	-0.02	0.908
Waist to hip ratio	-0.12	0.419
Index of slenderness	0.15	0.317
Rohrer's index	0.13	0.212
Pelvis-shoulder index	0.39	0.008**

Explanation: R - Spearman's rank correlation coefficient, p - significance level

The width of the pelvis is a parameter that deserves special attention, as the initiation of movement and leading in a dance couple takes place here, i.e. in the so-called centre - where the body's centre of gravity is located. This is one of the contact points of partners; in accordance with the pattern (Howard 1976), the right side of the male partner is in constant contact with the female partner's right side. Too wide a pelvis would close the partner's left side, which should remain open in standard dances.

A significant correlation of the pelvis-shoulder index is visible in the optimal differences that allow the correct positioning of the partners in relation to each other as well as the contact of the body from the hip to the breast in the basic posture of standard dances (Wieczysty 1986). The relative width of the pelvis in comparison with the shoulder width primarily affects the aesthetic image of the dancers.

The results indicate a very similar physique of partners (of course, taking into account the differences resulting from sexual dimorphism). Among the analysed morphological features, sexual dimorphism was clearly marked (exceeding the value of 1 ð) only on the level of adipose tissue. The absolute value of the index determines the degree of differentiation, which is higher when its value increases, whereas the positive values obtained prove the predominance of a given feature in women (table 3).

Table 3. Values of Mollison index of the studied morphological characteristics

Parameters	SD	WD
Body weight	4.391	-2.63
Level of adipose tissue	2.320	3.58
Level of muscle tissue	2.662	-2.54
Body height	5.532	-1.87
Pelvis width	2.286	-0.27
Waist circumference	3.796	-1.50
Hip circumference	7.720	-0.05

Explanation: WD - Mollison index, SD - standard deviation of partner characteristics

By analysing the obtained data, there can be found more similarities than clear differences between representatives of both genders. The results of own research have led to the conclusion that when selecting partners for dance couples, the relevance of selected values of morphological traits, as well as bodily proportion play an important role. However, there was observed a clear tendency of male and female dancers with low and medium body heights and athletic body type to specialize in Latin-American dances, while in standard dances this tendency was visible among male and female dancers with medium and high body height and leptosomatic body type. This is confirmed by the reports of other authors (Liiv et al. 2012, Šifrar & Zaletel 2014).

Conclusions

The current model of a competitive ballroom dancer is adapted to the tournament system, which is largely focused on assessing the aesthetics of the appearance of the dance couples. At the same time, the selection of partners by taking into consideration their somatic features is part of the judges' assessment. Aesthetic impressions are created by the body movement of partners, which is, in turn, determined by the level of body awareness achieved during psychological development and sexual maturity. This is the sphere where the dance judiciary system fails, making it that biological factors have a greater impact on the result than technical skills. The varied individual and intersexual dynamics of biological development necessitates a change of a partner during adolescence, as the disproportions that arise from therein disturb the fluidity of movements and aesthetics, which is subject to judges' assessment. In other artistic sports, such as rhythmic and artistic gymnastics, figure skating or synchronized swimming, somatic conditions also play a very important role (Francisco et al. 2012, Karniewicz & Kochanowicz 1990, Poliszczuk 2003, Monsma 2006, Kantanista et al. 2018), however, the appearance of the couple is not, as compared to technical skills, such a significant criterion of the final score as it is in ballroom dancing.

In this research work, efforts were made to assess information that could set the standards for the physique of dancers forming a dance couple. When creating such a somatic characterization, the most informative parameters were those that could be genetically controlled. Highly heritable are length dimensions, which are slightly higher in the case of men. However, in the case of women, width dimensions are stronger, which are characterized by slightly weaker genetic predisposition (Szopa et al. 2000) Other physical features show much weaker genetic predispositions, which causes their large

fluctuations during life depending on nutrition, lifestyle, physical activity, etc. The influence of heredity is particularly important when pairing up dancers, as poorly matched partners, at further stages of training, will not have opportunities to develop, since traits that are highly heritable will not undergo significant changes under the influence of sports training. Nevertheless, the obtained results allow concluding that systematic, multi-annual, task-oriented physical activity contributes to the approximation of the dimorphic differences in the distribution of adipose tissue. Thus, explicit gender differences within this component are eliminated. However, it should be considered whether the obtained result could have been influenced by the selection process itself. Only further observations and longitudinal studies can help interpret this issue.

Nevertheless, the obtained data may be helpful in the development and optimization of selection systems of dance partners for couples practicing competitive ballroom dancing.

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