Body Composition and Functional Abilities in Terms of the Quality of Professional Ballerinas

M. Mišigoj-Duraković[1], B. R. Matković[1], L. Ružić[1], Z. Duraković[2], Z. Babić[3], S. Janković[1] and M. Ivančić-Košuta[1]

[1] Faculty of Kinesiology, University of Zagreb, Zagreb, Croatia
[2] Department of Internal Medicine, University Hospital »Zagreb«, School of Medicine, University of Zagreb, Zagreb, Croatia
[3] University Hospital »Merkur«, School of Medicine, University of Zagreb, Zagreb, Croatia

A B S T R A C T

The objective of this research was to determine the variability of the sample of professional ballerinas in the space of characteristics of their body composition and some functional characteristics according to the requirements of their roles in ballet. The sample of examinees was comprised of 30 professional ballerinas, members of the Croatian National Theatre Ballet (15 soloists and 15 members of the corps de ballet). The data showed that the soloists were characterized by a significantly larger knee diameter, significantly lower thickness of skin folds on the trunk and the lower fat body mass percentage, as well as by greater grip strength. Aerobic capacity was only moderately more developed than in fit people who participated in physical exercising because of recreational reasons, and there were no differences between soloists and the members of the corps.

Introduction

Classical ballet and its independent stage expression date back to the end of the 16th century, whereas the first characteristics that distinguish the theatrical dance from classical ballet date back to the second half of the 18th century. In Croatia, the history of ballet is 120 years long. Although ballet has been researched from various historical and artistical aspects, bioanthropological and kinesiological research into ballet became more extensive in the last twenty years.

Most of the research was carried out on the samples of adolescent ballerinas[1–4], on the samples in which both the age of the examinees and their successfulness ranged widely[5,6], or less frequently on the small samples of elite professional ballerinas[7–10].

Ballet is a dramatic stage expression, which sets great requirements for functional, physiological, energy and motor abilities on the one hand, and the specifics of the somatotype characterized by an expressed sliminess of the body on the other.

The objective of this research was to determine the variability of the sample of professional ballerinas in the space of characteristics of their body composition and some functional characteristics according to the requirements of their roles in ballet.

Material and Methods

The sample of examinees was comprised of 30 professional ballerinas, members of the Croatian National Theatre Ballet. Out of the total sample 15 ballerinas were soloists of the average age 30.8 6.3 years, whereas the other 15 members of the corps de ballet were on the average 27.5 7.3 years old. All examinees have been engaged in ballet since they were 5 or 7 years old. Both sub-samples of ballerinas exercised on a daily basis, on the average 5 hours a day, and they all appeared on the stage on the average five times a month.

Apart from the listed descriptive indicators that refer to the chronological data such as age or the onset of menarche, the sample of variables comprised 17 anthropometric variables. On the basis of these anthropometric variables the body mass index was derived BMI = body mass (kg)/ body height^2 (m), as well as the components of body composition according to the method by Jackson and Pollock[11]: body fat percentage (%BF) and lean body mass (kg) according to Siri[12]:

BD = 1.089733 − 0.0009245 (X)
    + 0.0000025 (X)^2 − 0.0000979   age
(in years), and:

% BF = (495/BD) − 450 − 100

Whereas BD = body density, X = sum of triceps, suprailiac and abdominal skinfolds.

The measurement of functional characteristics encompassed the measurement of the grip strength (kp), flexibility of the trunk, pulmonary volumes: forced vital capacity (ml) – FVC and forced expiratory volume in the first second (ml) – FEV_1, maximal oxygen uptake – VO_{2max}, expressed in l/min and ml/kg/min, assessed on the basis of submaximal test on the cyclergometer according to Åstrand.

The anamnestic and the measurement data were first processed by means of descriptive statistics methods. Basic indicators of descriptive statistics were determined in the total sample, and in two sub-samples: the sub-sample of soloists and the sub-sample of corps de ballet members. The presence of differences in certain researched characteristics was tested by means of the Student's t-test.

Results

Table 1 displays the descriptive anthropometric indicators in the researched sub-sample of ballerinas. The data show that the sample was relatively homogeneous and that the sub-samples were not significantly different with regard to the age (soloists 30.8 6.36 and members of the corp 27.5 7.3), the onset of menarche (soloists 13.8 1.69 and members of the corp 14.2 1.83) and the training load volume.

In comparison with the members of the corps de ballet, the soloists displayed higher values of the average body mass (respectively 53.3 4.51 and 51.8 3.57) and of skeletal dimensions – both the longitudinal and the transversal ones – on the one hand, and lower values of the thickness of skinfolds on the other. There were significant differences in the knee diameter, in the thickness of skinfolds on

TABLE 1
ANTHROPOMETRIC CHARACTERISTICS OF PROFESSIONAL BALLERINAS – SOLOISTS AND
CORP DE BALLET MEMBERS – AND THE SIGNIFICANCE OF DIFFERENCES BETWEEN THEM

Variables	Soloists (N = 15)		Members of the corp de ballet (N = 15)		Student's t-test
	X	SD	X	SD	
Age (years)	30.8	6.36	27.5	7.3	1.33
Age at menarche (years)	13.8	1.69	14.2	1.83	−0.57
Body mass (kg)	53.3	4.51	51.8	3.57	1.02
Body height (cm)	165.6	5.20	163.5	5.69	1.01
Body mass index (BMI)	19.81	1.73	19.43	1.12	0.73
Leg length (cm)	92.1	4.15	90.6	4.24	1.00
Arm length (cm)	70.1	2.83	69.2	2.85	0.90
Biacromial span (cm)	36.9	1.33	36.4	1.99	0.92
Bicrystal span (cm)	27.9	1.39	27.3	1.19	1.34
Elbow diameter (cm)	5.82	0.64	5.67	0.50	0.76
Knee diameter (cm)	8.74	0.29*	8.47	0.35*	2.25*
Upper arm circumference flexed (cm)	23.34	1.24	23.5	1.65	−0.30
Upper arm circumference extended (cm)	24.9	1.50	25.1	1.77	−0.27
Forearm circumference (cm)	22.5	3.27	21.9	1.09	0.72
Thigh circumference (cm)	52.2	2.89	51.9	1.99	0.26
Calf circumference (cm)	34.2	3.82	34.9	1.71	−0.66
Subscapular skinfold (mm)	6.73	1.51	7.00	1.61	−0.46
Triceps skinfold (mm)	10.83	3.19	12.13	2.95	−1.15
Forearm skinfold (mm)	3.89	0.95	4.36	1.10	−1.25
Abdominal skinfold (mm)	4.96	2.10*	6.50	1.94*	−2.06*
Suprailiocrystal skinfold (mm)	3.53	0.81*	5.36	1.86*	−3.48*
Calf skinfold (mm)	7.46	2.74	7.50	2.74	−0.03
Body fat percentage (%)	12.7	2.59*	14.6	2.06*	−2.15*
Lean body mass (kg)	46.27	3.98	44.51	2.97	1.45

* p<0.05

the trunk, as well as in the percentage of body fat.

As for the population ballerinas, the soloists were thus characterized by the smallest proportion of body fat in the total body mass (respectively 12.7   2.59 and 14.6   2.06). Together with a somewhat bigger average body weight and a significantly larger diameter of the knee joint (respectively 8.74   0.29 and 8.47

0.35) they had a significantly lower percentage of body fat.

Table 2 displays in the same way the indicators of the investigated functional characteristics – these indicators show as a rule higher average values in soloists. Significant differences (at the level of p< 0.05) were proved, however, only for the grip strength (soloists 41.1   12.92 and members of the corp 31.5   2.93).

TABLE 2
FUNCTIONAL CHARACTERISTICS OF PROFESSIONAL BALLERINAS – SOLOISTS AND CORPS
DE BALLET MEMBERS – AND THE SIGNIFICANCE OF DIFFERENCES BETWEEN THEM

Variables	Soloists (N = 15)		Members of the corps de ballet (N = 15)		Student's t-test
	X	SD	X	SD	
Grip strength (kp)	41.1	12.92*	31.5	2.93*	2.59*
Flexibility (cm)	23.5	4.26	23.1	3.87	0.30
FVC (ml)	4008.3	542.33	3670.3	535.47	1.72
FEV1 (ml)	3449.7	454.41	3232.3	606.28	1.11
VO_{2max} (l/min)	2.79	0.68	2.63	0.72	0.62
VO_{2max} rel. (ml/kg/min)	52.02	10.36	50.61	14.02	0.30

*$p < 0.05$

Discussion

The mean age of the onset of menarche in ballerinas is 13.8 years in soloists and 14.2 in members of the corps de ballet, i.e. 14.04 on the average in the total sample of ballerinas. This age is older in comparison with the average age of the onset of menarche in the population of Croatian girls (12.6 years)[13]. This can probably be assigned both to an extreme sliminess of ballerinas, which implies low body mass and a small proportion of body fat in the total body composition, and to some environmental factors (nutrition, load intensity, etc.) which contribute to maintaining the body mass lower than the average values expected for this age and height that are the selection factors for engaging in ballet in the pre-school or in the early elementary school period.

The later onset of menarche in ballerinas is commonly referenced [6,9,14–16]. The frequency of the postponed onset of menarche (after 14 years of age) is described in various ranges (about 70%), the same as in female athletes whose sport events set similar requirements concerning somatotype and body composition[17].

The average values of particular skeletal dimensions, of body weight, of the diameter of extremities in the whole sample of ballerinas were mostly similar, whereas some were higher compared to the samples of professional top ballerinas described in literature[2,7]. The knee diameter, whose values were significantly higher in soloists, speaks in favor of the versatility of requirements, especially due to the fast tempo of certain music parts and the load exposed on the lower extremities when landing after the executed jumps. The thickness of skinfolds and the percentage of body fat was similar to the value of 12.8% reported by Cohen et all.[9] using Jackson and Pollock[11] method for elite female ballet dancers and described in literature for somewhat younger ballerinas, but lower than values of body fat percentage using different assessment methods[6,10]. Professional ballerinas are characterized by a smaller proportion of body fat in comparison to the younger adolescent ballerinas who still attend ballet schools and whose body fat proportion is mostly assessed to be about 20% of the total body mass[3,4].

As for the functional abilities, almost the same values of aerobic capacities in Croatian ballerinas (2.6 l/min; 51 ml/kg/min) were referenced by Schantz and Åstrand[8] on the basis of the direct measurements carried out on the sample of

ballerinas of the Royal Swedish Ballet, and there were also approximately by 5% higher values (not significant) in soloists when compared to the members of the corps de ballet, as shown in the study of ballerinas of the Croatian National Theatre. Professional grown-up ballerinas are commonly characterized by a higher aerobic capacity and a smaller proportion of body fat in the total body mass in comparison with the adolescent ballerinas[1,2]. Schantz and Åstrand[8] consider such referenced values of $VO_{2 max}$ to be low and to reflect the lack of aerobic conditioning training. The differences in functional indicators displaying higher values in soloists were significant only for the grip strength.

The soloists were characterized by a significantly smaller body fat proportion and consequently by a larger lean body mass – bone and muscle – in the total body mass. Specific requirements of solo performances in ballet were reflected in the space of functional characteristics as well.

Conclusion

Somatotype, body composition and functional abilities were analyzed on the total sample of 30 professional ballerinas from the Croatian National Theatre (15 soloists and 15 members of the corps de ballet). The results showed that the ballerinas were characterized by expressed sliminess of the body with significantly lower values of some skinfolds and of body fat percentage on the one hand, and on the other, by a bigger muscle mass in the total body mass of the soloists and bigger transversal dimensions of lower extremities (knee diameter). Grip strength was significantly greater in soloists. Aerobic capacity proved to be only moderately more developed than in fit people who participated in physical exercising because of recreational reasons and it did not display any differences between the subgroups.

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B. R. Matković

Faculty of Kinesiology, Horvaćanski zavoj 15, 10000 Zagreb, Croatia

SASTAV TIJELA I FUNKCIONALNE SPOSOBNOSTI VEZANO UZ RAZINU USPJEŠNOSTI BALERINA

S A Ž E T A K

U ukupnom uzorku od 30 profesionalnih balerina Hrvatskog narodnog kazališta (15 solistica i 15 članica ansambla) analizirana je građa, sastav tijela i funkcionalne sposobnosti. Rezultati su pokazali da ih karakterizira izrazita vitkost tijela sa značajno manjim vrijednostima nekih kožnih nabora i postotka masti, te većom mišićnom masom u ukupnoj masi tijela solistica, te većim transverzalnim dimenzijama donjih ekstremiteta (dijametar koljena). Jakost stiska šake značajno je veća u solistica. Aerobna sposobnost tek umjereno je razvijenija nego u dobrih rekreativaca, i ne pokazuje različitost u podskupinama.