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ARAŞTIRMA/RESEARCH

Physical characteristics of students to receive ballet training

Bale eğitimi alacak öğrencilerinin fiziksel özellikleri

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Abstract

Purpose: The aim of this study was to analyze the physical features of students who would receive ballet training.
Material and Methods: Students who applied for the examinations of Cukurova University State Conservatory Ballet Main Art Branch in the academic year 2013–2014 were included in the study. The enrolled students were evaluated as the experiment group, while the rejected students served as the control group. There were 31 girls in the experiment group and 20 girls in the control group. The physical features of groups were compared by using anthropometric measurements.
Results: Skinfold thickness values were significantly lower in the enrolled students. The right and left ranges of motion measurements of the enrolled students were significantly more than the control group; implicating that the enrolled students were more flexible than the rejected students.
Conclusion: The findings of this study may help to define the parameters of the physical features suitable for classical ballet education. These guidelines can be used to improve insufficient data about this subject in previous literature.
Key words: Ballet, student, anthropometry, flexibility

Öz

Amaç: Bu çalışmanın amacı bale eğitimi alacak öğrencilerin fiziksel özelliklerinin araştırılmasıdır.
Gereç ve Yöntem: Çalışmaya 2013–2014 eğitim öğretim yılında Çukurova Üniversitesi Devlet Konservatuvarı'nda bale eğitimi için sınava başvuran öğrenciler dahil edilmiştir. Sınavda uygun bulunan öğrenciler deney grubu, uygun bulunmayan öğrenciler ise kontrol grubu olarak belirlenmiştir. 31 kız öğrenci deney grubu ve 20 kız öğrenci ise kontrol grubu olarak değerlendirilmiştir.
Bulgular: Deri kıvrım kalınlığı ölçümleri bale öğrencilerinde daha düşük bulunmuştur. Ayrıca sağ ve sol eklem hareket genişliği parametrelerinde uygun bulunan öğrencilerin değerlerinin daha yüksek olduğu bulunmuş ve daha esnek oldukları sonucuna varılmıştır.
Sonuç: Klasik bale eğitimine uygunlukta kullanılacak fiziksel özellikleri belirleyen parametreler objektif olarak değerlendirilmiştir. Yapılan bu çalışmanın literatürdeki eksikliklerin giderilmesine katkı sağlayacağı düşünülmektedir.
Anahtar kelimeler: Bale, öğrenci, antropometri, esneklik

INTRODUCTION

Classical ballet is an art branch that requires artistic ability, excellent physical fitness, strength and flexibility. The bodies of ballet dancers often turn into the difficult positions, which are contrary to the normal anatomical and physiological characteristics in order to achieve superior properties for technical ballet requirements[1]. The science of anatomy is important as it translates the features of the body into the quantitative data. The professional and non-professional dancers' physical suitability and the optimum standards of the physical posture have been evaluated in recent researches[1]. Only 40% of the physical fitness of dancer standards is genetic-based while the remaining 60% is determined by regular exercise and balanced nutrition. Many recent researches have shown that dancers usually had insufficient levels of physical fitness. This finding is explained by various identification and evaluation criteria of the physical and physiological

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characteristics of the dancers and this has been emphasized as a major shortcoming of the related researches[1,2]. Classical ballet is also counterpart to sports like ice-skating and gymnastics, in that it requires volunteers to have large ranges of movement, or flexibility[3], along with performing jumps and other impermanent movements at a range of densities[4].

The aim of the current study was to analyze the physical features of students who were suitable for ballet training.

The other objectives of this study were to identify the physical features of ballet students to raise awareness for preventing the injury risks; to keep the bodies of the students fit and to inform the families and trainers about this process. Finally, another aim was to validate the information obtained from the anatomical research into ballet training.

MATERIAL AND METHODS

Study design

The population of the study included students who applied for ballet education to Cukurova University State Conservatory Ballet Main Art Branch. After a one-week of preparation program for ballet training, the students were subjected to various tests by the jury for three days. The anatomical measurements were done during these three days. The jury stayed blind to the anatomical measurements in order to avoid possible bias for assessments. After the official announcement of the jury results, the enrolled and rejected students for ballet education consisted two study groups. A cross–sectional observational analysis was performed on 31 female enrolled students and 20 female rejected students. Measurements were carried out in the studio in the Cukurova University State Conservatory. The subject tracking forms, informed consent forms and tools were prepared the studio was organized according to the measurement of the set-up procedure. The experimental procedures and the instruments for anatomical measurements were introduced to students and to their families in advance in order to achieve cooperation and written informed consents were completed before participation. The study was approved by Cukurova University Faculty of Medicine, Non–Invasive Clinical Research Ethics Committee and authorized from Cukurova University State Conservatory Ballet Art Branch of the President.

Participants

The population of the study consisted of on 51 girls who applied for the exams of Cukurova University State Conservatory Ballet Main Art Branch in the academic year of 2013-2014. 31 enrolled students formed the experimental group and 20 rejected students in the same age group served as controls. Table 1 shows the values related to age, body height (BH), body mass (BM) and body mass index (BMI) of the enrolled and rejected students.

Procedures

Each participant received physical evaluation including the measurements of the body dimensions for BM, skinfold thickness (ST), BH, lower extremity; thigh, crus, foot lengths, foot width, ankle and hip joint flexibility (JF). The same person performed all measurements for both left and right sides at the same day and place. During all the anthropometric measurements, the subjects were only in trunks, which were taken off during subscapular and suprailiac ST measurements. BMI, as a measure of voluminous of subjects was calculated by the formula; BMI; BM (kg) / BH (m^2)[5]. Anthropometric measurements BM, BH, lengths, foot width and ST were obtained according to Otman et al.'s guidelines except for the measurements of range of motions[6].

BH values were measured with stadiometer (Seca 213 stadiometer, CANADA), BM values were measured with weighing machine (Omron BF508 body composition monitor, JAPAN), lengths and foot width values were measured with digital caliper and anthropometer (Super Big Screen digital Caliper 0-150MM/0–6. Lafayette Large Anthropometer Instrument Model; 011290, USA) and ST values were measured with skinfold caliper (Lafayette skinfold model; 01290, USA). Bilateral hip and ankle active ranges of motions (ROM) were measured. The measurements of ROM were done according to Akdere and Çakıroğlu et al[7,8]. By using a digital inclinometer (Acumar digital inclinometer model; ACU001, USA). At hip abduction- adduction, pivot point was the anterior center of hip joint and at ankle dorsiflexion-plantarflexion, pivot position was the lateral malleolus on position of supine. Also, at hip internal-external rotation tuberosity of the tibia and at ankle inversion-eversion, pivot position was the base of calcaneus on sitting position.

Statistical analyses

Descriptive statistics for continuous variables are summarized as mean ± standard deviation (SD) in tables. Once data was tested for relevance to normal distribution, parametric or non-parametric methods were selected for the appropriate situation. While "Independent – Samples t test and Mann – Whitney U test" were used for independent group comparisons, "paired Student t test and Wilcoxon test" were used for the comparison of dependent groups . The significance level was accepted as P<0.05. IBM SPSS version 19 software package was used for statistical analysis in this study.

RESULTS

The means and SDs of the anthropometric characteristics of enrolled and rejected students are shown in Table 1, Table 2 and Table 3. As seen in Table 2, the biceps, triceps, suprailiac, subscapular and thigh skinfold thickness values were significantly lower in the enrolled students (P≤0.001) implicating thinner body structures in these students. As shown in Table 2, there were also differences in the right, left foot width and right left thigh length values between test and control groups. The right and left ranges of motion measurements of the enrolled students were higher than rejected students in all parameters (P<0.05) emphasizing that the enrolled students may be more flexible than the rejected ones (Table 3).

Table 1. The values of age, BH, BM and BMI of convenient and inconvenient students

	Convenient Students (n=31) Mean ± SD Med(Min–Max)	**Inconvenient Students (n=20) Mean ± SD Med(Min–Max)**	**P**
Age	9.51 ± 0.67 9.0(9.0–11.0)	10.20 ± 0.89 10.0(8.0–11.0)	**0.001**
BH (m)	1.38 ± 0.07 1.4(1.3–1.5)	1.43 ± 0.10 1.4(1.2–1.6)	**0.027**
BM (kg)	30.03 ± 4.85 28.6(22.4–39.5)	39.06 ± 6.94 28.6(26.8–56.8)	**<0.001**
BMI (kg/m2)	15.66 ± 1.40 15.4(13.5–19.2)	18.80 ± 1.90 15.4(15.7–21.9)	**<0.001**

SD; Standard Deviation. Med; median. Min; minimum. Max; maximum. P; significant value. n; number of people.BH; body height. BM; body mass. BMI; body mass index.

Table 2. The values of length, width and skinfold thickness (ST) of convenient and inconvenient students

Length Parameters	**Convenient Students (n=31) Mean ± SD**	**Inconvenient Students (n=20) Mean ± SD**	**P**
Thigh length (R) (cm)	33.69 ± 3.07	37.47 ±2.35	**<0.001**
Thigh length (L) (cm)	33.67 ± 2.99	36.83 ± 2.01	**<0.001**
Leg length (R) (cm)	30.43 ± 3.22	31.17 ± 4.43	0.529
Leg length (L) (cm)	30.25 ± 3.36	30.07 ± 4.24	0.864
Length of the lower extremity (R) (cm)	71.61 ± 6.09	73.33 ± 5.68	0.318
Length of the lower extremity (L) (cm)	71.28 ± 5.89	72.54 ± 5.24	0.443
Foot length (R) (cm)	19.21 ± 1.30	19.67 ± 1.30	0.229
Foot length (L) (cm)	19.02 ± 1.10	19.51 ± 1.31	0.158
Foot width (R) (cm)	7.24 ± 0.59	7.89 ± 0.63	**0.001**
Foot width (L) (cm)	7.22 ± 0.65	7.60 ± 0.60	**0.001**
Biceps ST (mm)	7.03 ± 1.37	10.68 ± 2.61	**<0.001**
Triceps ST (mm)	10.82 ± 2.08	14.63 ± 4.23	**0.001**
Suprailiac ST (mm)	7.26 ± 1.77	12.12 ± 2.53	**<0.001**
Subscapular ST (mm)	8.16 ± 2.37	11.46 ± 2.14	**<0.001**
Thigh ST (mm)	17.13 ± 3.42	23.58 ± 5.86	**<0.001**

R; right. L; left. ST; skinfold thickness. SD; Standard Deviation. Med; median. Min; minimum. Max; maximum. P; significant value. n; number of people.

Table 3. The right and left range of motion measurements of convenient and inconvenient students

Parameters	Convenient Students (n=31) Mean ± SD		Inconvenient Students (n=20) Mean SD		P*	P**
	R	L	R	L		
Ankle Dorsiflexion	17.79 ± 2.22	17.28 ± 2.15	14.80 ± 1.21	14.02 ± 0.86	**<0.001**	**<0.001**
Ankle Plantarflexion	63.55 ± 4.98	62.31 ± 5.21	46.46 ± 4.61	45.24 ± 4.26	**<0.001**	**<0.001**
Ankle Inversion	38.81 ± 1.98	37.70 ± 2.62	31.75 ± 2.27	30.40 ± 1.80	**<0.001**	**<0.001**
Ankle Eversion	19.90 ± 1.40	19.48 ± 1.60	16.92 ± 0.96	16.17 ± 0.98	**<0.001**	**<0.001**
Hip external rotation	48.34 ± 5.06	47.83 ± 5.56	39.58 ± 1.42	38.61 ± 1.30	**<0.001**	**<0.001**
Hip internal rotation	48.74 ± 4.20	46.99 ± 4.15	41.87 ± 1.02	41.12 ± 0.82	**<0.001**	**<0.001**
Hip abduction	46.24 ± 4.44	45.45 ± 5.54	37.09 ± 3.49	35.60 ± 3.38	**<0.001**	**<0.001**
Hip adduction	23.81 ± 2.05	21.60 ± 2.17	19.79 ± 1.11	19.55 ± 2.62	**<0.001**	**0.004**

R; right. L; left. SD; Standard Deviation. Med; median. Min; minimum. Max; maximum. P; significant value. n; number of people.
* The right range of motion measurements of Convenient Students and Inconvenient Students
** The left range of motion measurements of Convenient Students and Inconvenient Students

DISCUSSION

Classical ballet is a popular activity requiring intense physical demands[9]. The ballet is noted as an artistic demonstration by specific anatomical criteria with special emphasis on thin body structure[10]. There are many studies on the physical characteristics of the adolescent and adult professional ballet dancers in the literature but data for younger ballet students is rare[11]. Therefore, current study aimed to improve the knowledge about this subject in the literature. Previous literature reviews showed that the ballet professionals must be flexible, well balanced, aesthetic, stylish and have slim body structure[3,4,12-17]. In our study, these features were objectively evaluated by using anthropometric measurements.Leon et al. showed that professional ballet dancers have less body weight and BMI than folk dancers and modern dancers[18]. In addition, the ballet dancers were found to be weaker and have lower body fat when compared with the other dancers and, in addition, they were found to be thinner and longer as well when compared with normal population[2]. Our results demonstrated that BM and BMI values of convenient students were lower than inconvenient students ($P<0.05$). The finding of this study supported these results as the enrolled students had thinner skin. Bennel et al. recorded BM average of; 30.50±5.4 kg, height average of; 1.36±6.7 m and BMI average of; 16.30±2.1 kg / m2 in a population of female students from the ballet school at age 8–11 in Australia[19]. The values of enrolled students in our study are similar to ballet students in Australia.

Increasing the joint movement prevents the injuries due to increasing stress during the ballet training. Joint hyper flexibility is commonly considered as acceptable entrance criteria by various professional ballet schools[20]. Moreover, Esen et al., 2013 emphasized the importance of JF of ballet dancers for increasing professional success[21]. It was found that hip external rotation of the dancers is higher than non-dancers in the literature[12]. Similarly, the findings of a study conducted in Serbia showed that higher JF of the ballet dancers than modern dancers[10]. In an Australian ballet school, hip external rotation and internal rotation values of 8–11 years old ballet students at the end of 12 months of training were compared with a control group in the same age. According to this study, values of the 12 months "before and after" period of training the ballet students and the control group were respectively found as: the average hip external rotation; 33.3±12.3, 36.7±10.2 degrees and 45.0±9.6, 47.2±12.2 degrees while the average hip internal rotation; 26.9±14.5, 35.8±8.5 degrees and 39.0±11.5, 37.2±11.6 degrees[19].

The results showed that the ballet students were affected more positively after 12 months of training. In current study, JF values of the enrolled students are higher than ballet students in Australia, which is probably due to different measurement methods. While active method was used in this study; passive method was chosen measuring bilateral hip and ankle ranges of motions in the former study. Furthermore, hip external rotation average of 14–21 years old ballet students was 44.06±7.88 degrees, average hip internal rotation was 33.69±7.38 degrees in Hacettepe University State Conservatory in Turkey. Also, Reid et al. have found the hip external rotation average of the ballet dancers was 52 degrees22. In our study, JF values are higher than Hacettepe University ballet students but similar to the values of Reid et al. In literature, there are only a few studies analyzing normal JF values of healthy children. The study conducted in Philly, normal values of girls were identified as: hip abduction; 51 degrees, hip adduction; 18 degrees, hip external rotation; 48 degrees and hip internal rotation; 50 degrees[23] which are very similar to the JF values of the enrolled students in current study.

Our results showed that ankle JF values of enrolled students were higher compared to rejected students ($P<0.05$). In Boston Ballet School, ankle JF values of 8–13 years old ballet students were compared with a control group of the same age. According to this study, values of the enrolled students and the control group were respectively found as: the average ankle dorsiflexion R; 17.33±6.32 and 10.54±5.05 degrees, L; 16.98±5.20 and 10.12±4.76 degrees; the average ankle plantarflexion R; 60.21±6.29 and 52.74±4.78 degrees, L; 60.65±5.86 and 53.70±4.58 degrees[11]. Ankle JF values of enrolled students were higher than this control group and similar with the students' values in Boston Ballet School. In addition, the studies conducted in Asian populations, the values of hip external rotation and ankle dorsiflexion were found higher than western society[5].

According to the Livanelioğlu et al.'s study, in Hacettepe University State Conservatory, the ankle JF average values of 14–21 years old ballet students were found as: ankle dorsiflexion R; 4.56±9.19, ankle plantarflexion R; 79.33±7.94 degrees, ankle inversion; 33.81±6.33 degrees and ankle eversion; 42.47±9.92 degrees22. Ankle eversion and plantarflexion average values of enrolled students in our study were less, ankle inversion and dorsiflexion average values were higher when compared with ballet students in Hacettepe University State Conservatory. The reason for these differences might be that, Hacettepe University students' hip external rotation average was lower than the value of enrolled students in our study.

Average values of ST were significantly lower in the enrolled students when compared with controls ($P\leq0.001$). Micheli et al. conducted a 15-year follow-up (1996 to 2001) study between the ages of 17–32 on professional ballet dancers in Boston. They have assessed respectively that: biceps ST; 4.8±2.1 mm and 4.3±1.5 mm, triceps ST; 11.0±3.2 mm and 10.2±2.7 mm, suprailiac ST; 7.1±2.7 mm and 5.6±1.9 mm, subscapular ST; 8.5±2.4 mm and 8.1±2.1 mm, thigh ST; 15.4±3.9 and 14.0±3.4 mm13. In addition Hergenroeder et al. found the values of triceps ST; 10.9 mm, suprailiac ST; 8.90 mm, subscapular ST; 7.60 mm and thigh ST; 15.20 mm for ballet students aged between 13-18 in Houstan Ballet Academy[24]. Furthermore, Durakovic et al. evaluated triceps ST; 12.13±2.95 mm, suprailiac ST; 5.36±1.86 mm and subscapular ST; 7.00±1.61 mm in the average age of 30.8±6.36 in professional ballet dancers of Croatia[25]. Therefore, it can be concluded that ST values decreased with increasing professional level of ballet dancers.

The limitations of this study include insufficient number of participants and the lack of analysis of the gender factor. Further studies with larger populations including both genders are needed to improve the reliability of current results.

The findings of our study support that the enrolled students for ballet training had more aesthetic, flexible and thin body types compared to rejected students. Furthermore, right ranges of motion values of enrolled students were higher when compared to the left side. Therefore, increasing the left side exercises is recommended during the ballet training. There are some differences between the obtained values of this study and previous literature which is probably based on the differences in materials or methods. We also hope to be able to analyze the data throughout generations in following years in order to detect possible changes and any particular evolutions in these dimension values together with some other co-funding factors such as the effects of race, nutrition, living area and life style on human body size and flexibility. Moreover, the evaluation of the data obtained from the results of the study support the ballet training about personalize convenient students' education. This study have contributed to the objective criteria for the determination of physical properties of students for ballet education selection. The results may also help to prevent possible training injuries for students in advance by rejecting the students with unsuitable body types.

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