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The Effects of Some Anthropometric Features on Dynamic Balance

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Abstract

Various neurophysiological and mechanical factors (such as height, weight, body composition, the base of support, the length and weight of each limb) can affect the balance. This study aims to examine the effect of some anthropometric features on balance. Totally 22 healthy male athletes participated the study. Body weight and height parametres were measured before the balance measurements of the athletes, and then body mass indexes were calculated. Circumferential measurements and skinfold thickness were measured by using a caliper. Balance measurements of the athletes were calculated with the Biodex Balance System with dominant legs. In the study, while a significant positive correlation was found between body mass index body weight, knee joint diameters, thigh and calf circumference, and balance scores, no significant relationship was found between age, height, foot length, and foot width and all three balance scores. It could be said that body weight, knee joint diameter, body mass index, thigh and circumference characteristics of the study were significantly related to the balance scores in the positive direction but not regarding age, height, foot length and width characteristics.

Keywords: Foot length, foot width, balance, anthropometric features.

INTRODUCTION

It has been discussed which body profiles are appropriate for which branches in the studies conducted and the extent to which this issue will play important role in selecting skills in the background has been researched [1]. Balance is the process of maintaining the position of the body's center of gravity vertically over the base of support, in other words, the ability to sustain body center of pressure within the base of support necessary to maintain a position in space or a movement in a harmonized and controlled situation and against internal and external perturbation [6,9,19,20]. Accordingly, balance is of crucial importance in daily activities, optimizing performance and preventing injuries in sports [14,20]. The two types of static and dynamic balance play a significant role in achieving motor skills. Static balance is the one in which the individual retains poise in one single situation, whereas the dynamic balance is the body's ability to retain poise or steadiness when moving or shifting from one situation to another [17,20]. In order to effectively coordinate the movements and to achieve the maximum potential, athletes must master balance, which is essential for success in any sport [8,23,24] . Some evidence in the studies express that the better balance in the experienced athletes is mainly due to the repetitive exercises they do, which affects the dynamic responses [3,26]. Various neurophysiological and mechanical factors such as visual, vestibular, auditory, somatosensory and motor systems can change the balance [9]. Also, some anthropometric features such as height, weight, body composition, the base of support, the length and weight of each limb can mechanically affect the individuals' balance [21,26]. The factor specified as the base of support in the definitions is the area covered by the feet of a standing man. The literature has been examined with the assumption that the size of this area will positively affect the balance performance. A sufficient number of studies have not been found in the scientific literature on how the length and width of the feet affect balance performance. Thus, the study aims to examine the effect of foot length and width and some anthropometric properties on balance performance.

MATERIALS AND METHODS

Participants

There were 22 males aged 20-26 who actively participate in this research. The average age of the athletes was 22,55 ± 2,28 years, the average height was 1,79 ± 0,05 m, and the average body weight was 78,75 ± 9,37 kg. At the beginning of the study, each of the subjects was given detailed information about the risks and discomforts that could be encountered in the study, and the voluntary consent form was read and signed by the participant. All the volunteers participating in the research signed the informed consent (volunteer) form and filled personal information form.

Research Design

Subjects came to the Selcuk university sports science laboratory once (at 10 am). Afterward they came to laboratory, height (m), body weight (kg), knee joint diameter (cm), thigh circumference (cm), calf circumference (cm), foot width (cm), foot length (cm), thigh (subcutaneous fat mm), calf (subcutaneous fat mm) measurement were taken by instructors. Following the anthropometric measurement, participants were done to the balance performance test. Subjects did not involve any exercise sections 24 hours before the end of the test section. Participants were informed about the amount and type of food (60% carbohydrates, 30% lipids and 10% protein due to energy metabolism) that they had to take 24 hours prior to the first trial.

Dynamic Balance Test

The Subjects Postural control measures of subjects were performed using the Biodex Balance System (Biodex Balance System, Biodex Medical Systems Inc, Shirley, NY). System; It has a moving balance platform that can tilt up to 20° at 360° range of motion. There are adjustable levels of stability from one to 12. Level 1 has the lowest level of stability; level 12 has the highest level of stability. The platform is linked to computer software for objectively evaluating the equilibrium. With this software, postural scores can be obtained in anteroposterior and mediolateral directions as well as a general postural control score. The postural control score refers to the balance ability of the person in general, and the high balance score means that the balance performance is low [2,4,13]. During the postural control measurement subjects were tested on the platform with knees 45º slightly flexed on the dominant leg, the other leg 90º flexed and the arms crossed. During the test, the screen was covered, and the subjects were asked to look at a fixed spot about 1 meter from the eye. For postural control measurement, the platform was set to level 8 in open eyes condition. Subjects were allowed three practice trials before pre-exercise balance measurements, which lasted 20 seconds and practice and two practice done with open eyes. A 5-minute rest period was provided between each test.

Measurement of Height and Body Weight

The measurements are made by causing the subjects to be on measuring device with their bare foot and only shorts on them. Body weights are made by placing the Kaliper sliding on the scale in a way to touch the upper of the heads of the subjects while they are standing vertically on their foot and the height is read with the accuracy of 1 mm.

Circumference Width Measurement

It is measured with Anthropometric set.

Statistical Analysis

The statistical evaluation of the findings was performed with the SPSS 21.0 computer package program, and the arithmetic means and standard deviation of all parameters were calculated. Pearson's correlation analysis was used to evaluate the relationships between variables in our study. Differences in P <0.05 level were accepted as significant

RESULTS

Table 1 shows the age, height, body weight, body mass index, knee joint diameter, thigh circumference, calf circumference, foot width, foot length, thigh (subcutaneous fat) and calf (subcutaneous fat) average values of athletes participating in the study.

Table 1. Mean of anthropometric characteristics of subjects participating in the study

Parameters	N	Min.	Max.	Mean ± Sd. Dev.
Age (year)	22	20	26	22,55±2,283
Height (m)	22	1,70	1,91	1,79±0,05
Body Weight (kg)	22	66	105	78,75±9,37
Body Mass Index (kg/m2)	22	20,83	35,90	24,51±3,47
Knee joint diameter (cm)	22	9,6	12,8	10,31±0,71
Thigh circumference (cm)	22	48	67	54,89±4,53
Calf circumference (cm)	22	33	44	37,52±2,63
Foot width (cm)	22	5,7	9,7	8,21±0,80
Foot length (cm)	22	26,1	28,5	26,88±0,66
Thigh (subcutaneous fat (mm)	22	8,0	37,0	18,14±6,58
Calf (subcutaneous fat (mm)	22	7	24	16,34±4,95

Table 2. Average of balance performances of subjects participating in the study

Balance parametres	N	Min.	Max.	Mean ± Sd. Dev.
OSI (overall stability index)	22	1	3	2,20± 0,61
A/PI (anterior/posterior stability index)	22	0,7	2,9	1,60± 0,56
MLI (medial lateral stability index)	22	0,6	2,2	1,22± 0,36

In Table 2, the determining participants' OSI (overall stability index) balance average score was 2.20 ± 0.61, the A/PSI (anterior/posterior stability index) balance average score was 1.60 ± 0.56, and the M/LSI (medial/lateral stability index) balance average score was 1.22 ± 0.36.

Table 3. Correlation Analyzes of Participants in the Study

Parameters		OSI	A/PI	MLI
Age	Pearson Correlation	,034	,141	-,224
	Sig. (2-tailed)	,881	,532	,316
Height	Pearson Correlation	-,112	-,037	-,338
	Sig. (2-tailed)	,621	,871	,124
Body Weight	Pearson Correlation	,703**	,580**	,571**
	Sig. (2-tailed)	,000	,005	,006
Knee joint diameter	Pearson Correlation	,675**	,644**	,475*
	Sig. (2-tailed)	,001	,001	,025
Thigh circumference	Pearson Correlation	,690**	,610**	,575**
	Sig. (2-tailed)	,000	,003	,005
Calf circumference	Pearson Correlation	,681**	,543**	,621**
	Sig. (2-tailed)	,000	,009	,002
Foot width (cm)	Pearson Correlation	,119	,101	-,069
	Sig. (2-tailed)	,597	,655	,759
Foot length (cm)	Pearson Correlation	,209	,334	-,102
	Sig. (2-tailed)	,352	,129	,651
BMI	Pearson Correlation	,666**	,522*	,653**
	Sig. (2-tailed)	,001	,013	,001

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

DISCUSSION

The protection of the balance, which is based on all movements and influenced by various factors, is effected by visual, kinesthetic and vestibular stimuli. Besides, balance is necessary for the realization of motor skills [10]. Factors such as age and height are essential factors in balance [1]. However, no statistically significant relation was found between age and height parameters and balance scores in our study. This finding is similar to studies of Moein & Movaseghi [20] and Tabrizi et al., [26]. While there was no correlation between eyes-open OSI, A/PSI and M/LSI balance scores and age of male and female subjects in Alonso et al. [1] study, they found a significant relationship only between women's A/PSI balance scores with eyes closed and their ages.

The same relationship was also established between male and female eyes closed M/LSI balance scores and height. This difference emerges as a sign of increased balance oscillation when the eyes are closed. Also, according to Vieira et al. [27] and Cavalheiro et al., [5] there is no correlation between age performance and age in young adults, which is similar to our result. However, Hue et al. [15] stated that the difficult conditions and the aging were deteriorating the balance performance.

A positive and significant relationship was found between the body weight and BMI parameters and all three balance scales (OSI r = 0.703, p = 0,000; A/PSI r = 0.580, p = 0.005; M/LSI r = 0.571 p = 0.006) in the presented study. Greve et al. [11] found significant correlations between BMI and body weight and balance scores in the positive study. Alonso et al. [1] reported that individuals with larger body mass and soft tissue mass had greater M/LSI and A/PSI balance swings when the eyes were open and closed. Similarly, Singh et. al. [25] reported a positive relationship between body mass index and balance scores in young adult subjects. Also, it was also reported that the balance performances of people with a body mass index of 40 kg / m2 were deteriorated especially in long-standing exercises. Rozzi et al. [22] and Lee & Lin [18] stated that girls have more balance oscillation than boys have.

As the body weight increases, the balance score increases positively, but the balance

performance is deteriorated. In the study, it was seen that subjects had a high level of a significant relation between knee joint diameter, thigh and calf circumference and OSI, A/PSI and M/LSI balance scores. That is, as the circumference of the knee joint, thigh and calf increases, the balance oscillations increase in a positive direction. This important relationship is similar to the findings of Tabrizi et al. [26] However; it contradicts the findings of Moein & Movaseghi [20]. It is thought that this contradiction came from the fact that Moein & Movaseghi [20] worked on sedentary ladies. In addition, according to the literature, increase in diameter and circumference measurements of persons and rise in weight centers increase postural oscillation [11,15,16]. There was no significant relationship between foot length, width and all three balance scores in the study conducted. However, unlike our study, Fabunmi & Gbiri [9] and Habib et al. [12] found a significant relationship between foot length and balance. Cote et al. [7] reported that static and dynamic balance was significantly affected in those with foot supination and pronation. It can be stated that the researchers using different balance tests, measurement and analysis methods and researches with varying groups of age can cause this difference.

Conclusions

In conclusion, we could say that body weight, knee joint diameter, body mass index, thigh and circumference characteristics of the study were significantly related to the balance scores in the positive direction but not regarding age, height, foot length and width characteristics

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Conflicts of Interest

The authors declare no conflict of interest.

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