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Relationship between body composition and somatotype with dynamic postural balance in young basketball players

Relación entre composición corporal y somatotipo con equilibrio postural dinámico en jóvenes basquetbolistas Relación entre composición corporal y somatotipo con equilibrio postural dinámico en jóvenes basquetbolistas

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Abstract. Objective: The aim of this study was to determine the relationship between body composition and somatotype with dynamic postural balance in young basketball players. Methods: The sample included 33 young male athletes aged (17.03 ± 0.94 years old). Body composition and somatotype were obtained from anthropometric measurements of diameters, perimeters, and skinfolds. Dynamic postural balance was measured with the modified star excursion balance test (mSEBT) in anterior, posteromedial, and posterolateral directions. The Pearson correlation test was used to identify the relationship between body composition and somatotype variables with the dynamic postural balance of the athletes. Results: In the dominant lower limb, body composition showed significant correlations for the anterior direction of the mSEBT with adipose mass (r=-0.741; p=0.001), muscle mass (r=0.662; p=0.009), endomorph (r=-0.822; p=0.009) and ectomorph (r=0.790; p=0.002). Adipose mass also showed significant relationships with the posteromedial (r=-0.413; p=0.037) and posterolateral direction of mSEBT (r=-0.291; p=0.041). In the non-dominant lower limb, in the anterior direction of the mSEBT, there was a significant correlation with the adipose mass (r=-0.691; p=0.009), muscle mass (r=0.472; p=0.025), endomorph (r=-0.778; p=0.001) and ectomorph (r=0.843; p=0.001) somatotypes. Adipose mass was also correlated with the posteromedial (r=-0.451; p=0.012) and posterolateral (r=-0.390; p=0.022) directions of the mSEBT. Conclusions: In the present study, it was possible to find a relationship between the percentage of fat mass, muscle mass, endomorph, and ectomorph somatotypes with the performance of dynamic postural balance in young basketball players.
Keywords: postural control, postural balance, athletes, sports, anthropometry, somatotype.

Resumen. Objetivo: El objetivo de este estudio fue determinar la relación entre la composición corporal y el somatotipo con el equilibrio dinámico en jóvenes jugadores de baloncesto. Métodos: La muestra estuvo compuesta por 33 deportistas varones jóvenes de edad (17,03 ± 0,94 años). La composición corporal y el somatotipo se obtuvieron a partir de medidas antropométricas de diámetros, perímetros y pliegues cutáneos. El equilibrio postural dinámico se midió con la prueba de equilibrio de excursión en estrella modificada (mSEBT) en las direcciones anterior, posteromedial y posterolateral. Se utilizó la prueba de correlación de Pearson para identificar la relación entre las variables de composición corporal y somatotipo con el equilibrio postural dinámico de los atletas. Resultados: En el miembro inferior dominante, la composición corporal mostró correlaciones significativas para la dirección anterior del mSEBT con masa adiposa (r=-0,741; p=0,001), masa muscular (r=0,662; p=0,009), endomorfo (r= -0,822; p=0,009) y ectomorfo (r=0,790; p=0,002). La masa adiposa también mostró relaciones significativas con la dirección posteromedial (r=-0,413; p=0,037) y posterolateral de mSEBT (r=-0,291; p=0,041). En el miembro inferior no dominante, en la dirección anterior del mSEBT, hubo una correlación significativa con la masa adiposa (r=-0,691; p=0,009), masa muscular (r=0,472; p=0,025), endomorfo (r=-0,778; p=0,001) y ectomorfo (r=0,843; p=0,001) somatotipos. La masa adiposa también se correlacionó con las direcciones posteromedial (r=-0,451; p=0,012) y posterolateral (r=-0,390; p=0,022) del mSEBT. Conclusiones: En el presente estudio fue posible encontrar una relación entre el porcentaje de masa grasa, masa muscular, somatotipos endomorfo y ectomorfo con el desempeño del equilibrio postural dinámico en jóvenes basquetbolistas.
Palabras clave: control postural, equilibrio postural, deportistas, deportes, antropometría, somatotipo.

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Introduction

Basketball is one of the most widely played sports and has millions of followers worldwide (Gur, Soyal, & Dogan, 2022). It is considered a high-intensity sport, in which the athletes performance depends on various physical characteristics and specific motor skills such as running, jumping, and postural balance (Gur et al., 2022; Mancha-Triguero, García-Rubio, Gamonales, & Ibáñez, 2021; Méndez-Rebolledo, Guzmán-Muñoz, Gatica-Rojas, & Zbinden-Foncea, 2015). It has also been described that body composition and somatotype are also factors that could determine basketball performance. Regarding body composition, it has been reported that the percentage of body fat in young and professional basketball players is close to 11% and 14%, respectively (Gryko, Kopiczko, Mikołajec, Stasny, & Musalek, 2018). Furthermore, the somatotype in young basketball players is closer to ectomorphy (Gryko et al., 2018), while in professional basketball players it is closer to mesomorphy (Gryko et al., 2018; Ochoa Martínez, Hall López, Alarcón Meza, Arráyales Millán, & Sánchez León, 2014). In other populations, it has been seen that an increase in body fat negatively affects postural balance (Guzmán-Muñoz, Valdés-Badilla, Mendez-Rebolledo, Concha-Cisternas, & Castillo-Retamal, 2018; Morales-Vargas, Valdes-Badilla, & Guzmán-Muñoz, 2021), while those with a mesomorphic somatotype show better postural balance (Samaei, Bakhtiary, & Hajihasani, 2014).

Postural balance is defined as a complex motor skill resulting from the interaction of a number of sensorimotor processes directed at controlling the body in space (Horak, 2006). This ranges from anticipatory and compensatory strategies to input information from the visual, vestibular, and somatosensory systems for integration into the central nervous system (Horak, 2006; Maurer, Mergner, & Peterka, 2006). Postural balance can be evaluated using methodologies based on force platforms (i.e., displacement of the center of pressure) and observational recording batteries [e.g., star excursion balance test (SEBT), the movement assessment battery for children (MABC), etc.]. One of the most widely recognized methods for assessing dynamic postural balance in young athletes is the mSEBT (Gribble, Hertel, & Plisky, 2012). The mSEBT protocol evaluates three directions: anterior, posteromedial, and posterolateral (Gribble et al., 2012). In young athletes, the mSEBT has been frequently used to assess dynamic postural balance (Mendez-Rebolledo et al., 2021; Morales-Vargas et al., 2021; Sáez-Michea et al., 2023; Vásquez-Orellana, López-Vásquez, Méndez-Rebolledo, & Guzman Muñoz, 2022). Postural balance has been found to be better in young basketball players than in non-basketball adolescents, mainly in the posteromedial and posterolateral reach of mSEBT (Curtolo et al., 2017). However, there is limited information about to how body composition and somatotype could influence postural balance performance in young basketball players.

Knowing how body composition and somatotype influence postural balance in young basketball players would be very useful for the selection of athletes and training planning since the previously exposed antecedents would indicate that postural balance may be a relevant factor in sports performance. Therefore, the objective of this study was to determine the relationship between body composition and somatotype with dynamic postural balance in young basketball players.

Material y Methods

The design of this research was observational and cross-sectional. The participants were selected under non-probabilistic convenience sampling. All participants signed a consent term following the Declaration of Helsinki and were approved by the local University Ethics Committee (registration number 13420). The present investigation was conducted in the Human Motion Analysis Laboratory of the Universidad Santo Tomás in the cities of La Serena and Talca (Chile). All procedures and research reports were carried out in accordance with the STROBE statement (von Elm et al., 2014).

Participants

The sample included 33 young male athletes (age 17.03 ± 0.94 years, body mass = 78.62 ± 10.13; height = 1.81 ± 0.09; BMI = 24.02 ± 4.65). These athletes belonged to two Chilean school basketball teams and had been practicing the sport for at least two or more years. The following exclusion criteria were considered: a) musculoskeletal injuries in the last three months; b) surgery in the last six months on the upper or lower body; c) discomfort of any type when making the evaluations (e.g., pain, fatigue, dizziness).

Body composition and somatotype

The recommendations of the International Society for Advances in Kinanthropometry (ISAK) were followed to carry out the evaluations. Bipedal height was first assessed with a stadiometer (Seca, Hamburg, Germany; precision 0.1 cm) and body weight with a digital scale (Seca, Hamburg, Germany; precision 0.1 kg). BMI was calculated by dividing body weight (kg) by standing height squared (m2). Subsequently, the diameters were evaluated with anthropometers (Rosscraft, Canada, precision 0.1 mm), the perimeters with a tape measure (Sanny, Brazil, precision 0.1 mm), and the skinfolds with a caliper (Harpenden, England, precision 0, 2mm). Anthropometric measurements consisted of six diameters (biacromial, transverse thorax, anteroposterior thorax, bicrestal, biepicondylar humerus, and biepicondylar femur), ten girths (head, relaxed arm, flexed arm in tension, maximum forearm, mesosternal thorax, minimum waist, maximum hip, maximal thigh, medial thigh, and maximal calf) and six skinfolds (triceps, subscapular, supraspinal, abdominal, medial thigh, and maximal calf). These evaluations made it possible to obtain the body composition as proposed by Kerr (Kerr, 1988), which establishes five components (pentacompartmental method): adipose, muscle, residual, bone, and skin mass. On the other hand, the somatotype was determined according to Carter & Heath (Carter & Heath, 1990), who defined the quantification of the shape and composition of the human body through three numbers that represent: endomorphy, mesomorphy, and ectomorphy.

Postural balance

Dynamic postural balance was evaluated using the dynamic mSEBT test considering three directions: anterior, posteromedial, and posterolateral (Gribble et al., 2012). Each participant started the test bipedal with hands on the waist. Participants were instructed to reach the greatest possible distance with the lower limb tested in each of the directions of the test. The dominant and non-dominant lower limb was evaluated. Three attempts per direction were given, and the average of these was recorded. The attempt was considered valid when the support foot did not leave the ground, and the participant recovered the initial position without losing balance after performing the reach (Gribble et al., 2012). To measure the distances reached in the 3 directions, a tape measure in centimeters (Sanny®, Brazil; precision of 0.1mm) was used. The final value of the reach of the extremity was expressed as a percentage being normalized from the length of the lower limb (score % = [reach distance cm/limb length cm] x 100) (Gribble et al., 2012). The length of the lower limb was measured considering the distance between the anterior superior iliac spine and the medial malleolus of the ankle (Gribble et al., 2012).

Statistical Analysis

Data were analyzed with SPSS 25.0 statistical software (SPSS 25.0 for Windows, SPSS Inc., IL, United States). The mean and standard deviation were calculated to describe the characteristics of the sample, body composition, somatotype, and dynamic postural balance. The Shapiro-Wilk test was applied to evaluate the distribution of the data. Since the data had a normal distribution, the Pearson correlation test was used to identify the relationship between body composition and somatotype variables with the dynamic postural balance of the athletes. A correlation coefficient *r* of 0 to 0.4 was considered as weak, a coefficient of 0.4 to 0.7 was considered as moderate, and a coefficient of 0.7 to 1.0 was considered as strong relationship. The level of significance for all statistical tests was $p < 0.05$.

Results

The anthropometric characteristics (body composition and somatotype) of the young basketball players evaluated are presented in Table 1. Table 2 shows the results of the mSEBT in both the dominant and non-dominant lower limbs.

Table 1.
Body composition and somatotype of the male young basketball players evaluated.

Anthropometric variables	Mean	SD
Fat mass (%)	30.13	5.18
Muscle mass (%)	43.07	4.09
Residual mass (%)	10.12	0.78
Bone mass (%)	11.74	1.39
Epithelial mass (%)	4.93	3.11
Endomorph	4.41	2.38
Mesomorph	5.30	1.11
Ectomorph	1.96	1.20

Table 2.
Dynamic postural balance in young basketball players evaluated.

Reach directions	Mean	SD
Anterior DLL (%)	75.22	7.11
Anterior NDLL (%)	74.32	8.55
Posteromedial DLL (%)	99.13	10.75
Posteromedial NDLL (%)	97.90	11.34
Posterolateral DLL (%)	99.77	9.09
Posterolateral NDLL (%)	99.21	9.21

DLL: dominant lower limb; NDLL: Non-dominant lower limb

Table 3 shows the results of the correlations between dynamic postural balance with body composition and somatotype in the dominant and non-dominant lower limbs. In the dominant lower limb significant correlations were observed for the anterior direction of the mSEBT with fat mass (r = -0.741; p = 0.001), muscle mass (r = 0.662; p = 0.009), endomorphism (r = -0.822; p = 0.009) and ectomorphism (r = 0.790; p = 0.002). The positive correlations indicate that the greater the reach in mSEBT, the greater the muscle mass and ectomorphism. While the negative correlations indicate that the greater the reach in mSEBT, the lower the fat mass and endomorphism. Fat mass also showed negative significant relationships with the posteromedial (r = -0.413; p = 0.037) and posterolateral direction of mSEBT (r = -0.291; p = 0.041).

In the non-dominant lower limb, for the performance in the anterior direction of the mSEBT, there was a significant correlation with the fat mass (r = -0.691; p = 0.009) and muscle mass (r = 0.472; p = 0.025). That is, the greater the reach in mSEBT, the less fat mass, and the greater the muscle mass. Fat mass was also correlated with the posteromedial (r = -0.451; p = 0.012) and posterolateral (r = -0.390; p = 0.022) directions of the mSEBT. In addition, significant relationships were established between the anterior direction of the mSEBT and the endomorph (r = -0.778; p = 0.001) and ectomorph (r = 0.843; p = 0.001) somatotypes. That is, the greater the reach in mSEBT, the less endomorph and the greater ectomorph.

Table 3.
Relationship between the postural balance of the dominant and non-dominant lower limb with body composition and somatotype.

	Anterior		Posteromedial		Posterolateral	
	DLL	NDLL	DLL	NDLL	DLL	NDLL
Fat mass (%)	-0.74*	-0.69*	-0.41*	-0.45*	-0.29*	-0.39*
Muscle mass (%)	0.66*	0.47*	0.07	0.29	0.14	0.17
Residual mass (%)	0.54	0.51	0.29	0.22	0.05	0.07
Bone mass (%)	0.49	0.60	0.31	0.39	0.50	0.19
Epithelial Mass (%)	0.51	0.41	0.15	0.06	0.30	0.05
Endomorph	-0.82*	-0.78*	-0.31	-0.08	0.21	-0.23
Mesomorph	-0.43	-0.52	0.02	-0.01	0.32	0.14
Ectomorph	0.79*	0.84*	0.21	0.15	0.49	0.11

*DLL: dominant lower limb; NDLL: non-dominant lower limb. *p<0.05 Pearson correlation test*

Discussion

The aim of this study was to determine the relationship between body composition and somatotype with dynamic postural balance in young basketball players. The main findings of this research indicate a correlation between some variables of body composition and somatotype with the performance of the dynamic postural balance. It was observed that both for the dominant and non-dominant lower limb, fat mass negatively influences the performance of the three directions of the mSEBT. In contrast, muscle mass was positively related to the performance of postural balance only in the anterior direction of the test. For their part, the endomorph and ectomorph somatotypes influence the performance of the anterior reach of the dynamic postural balance in a negative and positive way, respectively. These results agree with those reported in other athletes, where it has been seen that variables related to the accumulation of adipose tissue, such as body mass index and percentage of body fat, have been negatively associated with the performance of postural balance (Hartley, Hoch, & Boling, 2018; Morales-Vargas et al., 2021). Specifically, young basketball players have observed that a higher percentage of fat mass is related to poor postural balance (Kostopoulos, 2015).

Previous studies have shown that excess adiposity decreases postural balance in both children and non-athletic adults (Brech et al., 2021; Cancela Carral, Ayán, Sturzinger, & Gonzalez, 2019; Guzmán-Muñoz et al., 2018). However, antecedents in athletes have been investigated less. In our study, it was found hat variables related to the accumulation of adiposity such as the percentage of fat mass and endomorphy negatively influence the dynamic postural balance. It has been proposed that the accumulation of fatty tissue around and within the muscle could alter the standard mechanisms of motor responses due to physiological and neuromuscular changes (Morales-Vargas et al., 2021; Pajoutan, Ghesmaty Sangachin, & Cavuoto, 2017). The accumulation of fat would increase the expression of proinflammatory cytokines in the muscle, which could reduce the electrochemical balance and neural conductivity (Addison et al., 2014). These changes in muscle fiber would generate a decrease in the muscle fibers conduction velocity and in turn arthrogenic muscle inhibition, reducing the neuromuscular response capacity of the adjacent muscles (Addison et al., 2014; Pajoutan et al., 2017; Park et al., 2017). Likewise, it has been seen that individuals with greater body fat present alterations in both anticipatory and compensatory neuromuscular activation patterns (Mendez-Rebolledo et al., 2019). This would affect the muscular response due to lower neuromuscular efficiency in the recruitment of motor units.

In our study, it was possible to reveal that muscle mass is an anthropometric variable influencing postural balance in young basketball players. Specifically, a higher percentage of muscle mass was associated with better dynamic balance performance in the anterior direction of the mSEBT in the dominant and non-dominant lower limbs. This is similar to that reported in other athletic and non-athletic populations (Patlar, Yilmaz, & Tatlici, 2020; Walsh, Low, & Arkesteijn, 2022). It has been suggested that greater muscle mass is essential for adequate motor function (Gadelha et al., 2018; Walsh et al., 2022). Nonetheless, muscle quality has been singled out as one of the most important muscle-related indicators of postural balance performance (Gadelha et al., 2018). Muscle quality has been defined as a relationship between strength and muscle mass (Walsh et al., 2022). A study highlighted that a higher muscular quality of the lower extremities is related to a better postural balance (Walsh et al., 2022). Although muscle strength was not measured in this research, muscle mass is one of the components considered in muscle quality, which could explain the finding evidenced in our results.

The importance of postural balance in sports has been widely studied. Poor postural balance has been shown to be associated with an increased risk of injury (Andreeva et al., 2021; Gribble et al., 2012; Plisky, Rauh, Kaminski, & Underwood, 2006). Likewise, it has been seen that an effective postural balance is a good prerequisite for improving the control of voluntary movements in sports and, consequently, for enhancing athletic performance (Andreeva et al., 2021; Paillard, 2002). Therefore, knowing which are the anthropometric parameters that favor or limit the development of postural balance is crucial in the sports development of athletes.

Among the limitations of this study is the non-probabilistic selection of participants could increase the type I error of the investigation. On the other hand, body composition and somatotype are estimated indirectly from measurements of diameters, perimeters, and skinfolds. Despite this, it is a widely accepted method in scientific research.

Conclusion

There is a relationship between the performance of dynamic postural balance with percentage of adipose mass, muscle mass, and endomorph and ectomorph somatotypes in young basketball players. These antecedents suggest that there are certain anthropometric profiles that could limit or enhance dynamic postural balance and potentially influence the general performance of the athlete.

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