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Posted Date: 21 January 2025

doi: 10.20944/preprints202501.1551.v1

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Relationship Between Body Composition, Somatotype and Physical Abilities in Young Selected Chilean Basketball Players

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Abstract: To analyze the relationship of sprinting and agility with body composition, adiposity, and somatotype in young Chilean basketball players. **Material and Method:** The research design is non-experimental, descriptive transectional. 20 Chilean under-14 category basketball teams participated, and their anthropometric characteristics were evaluated using a scale and a stadiometer. Their speed and agility were measured through the use of photocells during field tests. The relationship between the variables was established with the Pearson correlation coefficient. In addition, a simple linear regression analysis was carried out, where R, R2, the standard error of estimation (SEE) and the unstandardized beta coefficient (β). All analyses were performed using SPSS statistical software IBM Corp. version 17.0, considering a significance level of $p < .05$. **Results:** A direct and positive correlation is observed between the Illinois agility test and the anthropometric indicators of body weight ($r=0.75$; $p<0.01$) and height ($r=0.48$; $p<0.05$). Likewise, a positive relationship was found between the agility test and the adiposity parameter, ∑ folds ($r=0.71$; $p<0.01$), while an inverse and negative relationship was found with ectomorphism ($r= -0.46$; $p< 0.05$). Furthermore, a direct and positive correlation is observed between endomorphism and the 5 m sprint ($r=0.62$; $p<0.01$) and the 10 m sprint ($r=0.60$; $p<0.01$). **Conclusion:** There is a significant relationship between body composition and the physical abilities of sprinting and agility in young Chilean basketball players.

Keywords: body composition. basketball. sprint. agility

Introduction

Basketball is a widely popular sport worldwide, with approximately 450 million players, according to the International Basketball Federation [1]. It is characterised by its dynamism and the need to use both aerobic and anaerobic energy systems to perform a variety of movements, jumps,

 doi:10.20944/preprints202501.1551.v1

sprints, changes of direction, along with technical executions, coordinated tactical behaviours in attack and defense throughout the game. [2, 3]. Speed and agility are fundamental elements in most of the defensive and offensive actions performed by basketball players both during training and in games. [4]. In this context, being able to perform repeated high-intensity sprints with short recovery intervals is essential, as it is considered a crucial aspect of performance [5]. This is particularly relevant as basketball players have unique physical characteristics that distinguish them from other athletes. They are taller, heavier and have longer limbs. These factors, along with body fat percentage and body diameters, are determinants of performance in the sport [6]. From an anthropometric perspective, height is considered to be the most relevant physical attribute in basketball. Specifically, this factor plays a crucial role in the identification and selection of talent in this sport. [2]. In this sense, the quantification of the demands faced by athletes during competition is important to optimise training processes [7]. During training, it is essential that athletes are adequately prepared to achieve the best results in terms of sporting performance [8]. In this regard, it is essential to adopt a personalised approach and to carry out anthropometric evaluations [9], as well as physical performance tests, such as power and aerobic capacity, which play a crucial role in today's sport as part of the selection process and long-term career development [10].

In different sport disciplines, including basketball, assessing body composition is a common practice [11]. Therefore, having a more favourable body composition, with less fat mass, could be beneficial. In fact, it has been found that the proportion of adipose mass (AM) is negatively related to the ability to perform explosive movements such as changes of direction and vertical jumps [3,12]. Similarly, it is important that coaches take into account the different anthropometric and physical profiles of players according to their position in the game when designing training programmes [13]. Previous studies mention that it is widely known that there are significant connections between jumping performance, running speed, and agility in basketball players [14, 15]. To achieve success, basketball players must attain a significant level of physical capacity, muscular strength and possess an ideal body composition that aligns with their specific role within the team [16]. However, the influence of morphological changes on speed and agility in young players between the ages of 12 and 16 is not yet fully understood. There are differences between age groups that can be attributed to diversity in muscle mass, muscle structure and muscle fibre types, and puberty, growth spurt during adolescence, relative age and maturity level also influence variation in speed and agility [17,18]. Furthermore, there is still a paucity of literature available that addresses the relationships between anthropometric assessment and physical performance in young elite basketball players, relative to adult players [19]. For these reasons, the aim of this study is to analyse the relationship between sprinting and agility with anthropometry, adiposity and somatotype in young Chilean basketball players.

Materials and Methods

2.1. Participants

In July 2019, an evaluation was carried out in Collipulli, Chile, where 20 Chilean basketball players of the U-14 male category participated. These players were part of the concentration processes of the national team, organised by the Chilean Basketball Federation. The age of the group was 13.72 ± 0.45 years, with a body weight of 71.30 ± 9.60 kg and a height of 181.44 ± 5.77 cm. on average, respectively. Two inclusion criteria were established for those wishing to participate in this evaluation.

The first was to be called up by the Chilean Basketball Federation to the national team in the U14 category. The second criterion was to have signed the required informed consent form. On the other hand, those who did not have complete information on the variables collected were excluded from the evaluation.

2.2 Procedures

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All participants and the technical staff were informed about the objectives of the study and gave their consent by signing an appropriate form. They were also provided with recommendations on the procedures to be followed during data collection. On this occasion, the athletes were instructed on the steps necessary to carry out the physical and anthropometric assessments, thus ensuring compliance with ethical principles in human subjects research. In addition, approval was obtained from the ethics committee of the Adventist University of Chile (code 2021-40).

2.3. Protocols and instruments

2.3.1. Anthropometric measurements

The anthropometric evaluation was carried out in the facilities of the Collipulli municipal gymnasium, by three level 2 evaluators, together respective level 1 assistants certified by the ISAK (International Society for Advancement in Kinanthropometry), who carried out the anthropometric evaluation. The margin of technical measurement error, both intra- and inter-evaluator, is within the limits recommended by the ISAK, which are less than 5% for skinfolds and less than 1% for all other measurements. All measurements were performed on the right side and repeated once, following the International Standardisation Manual for Anthropometric Standardisation published by the ISAK [20]. In total, 23 measurements were performed, including height, weight and various skinfolds (triceps, subscapular, biceps, iliac crest, supraspinal, abdominal, mid-thigh, medial calf), perimeters (relaxed and contracted arm, maximal forearm, wrist, thorax, waist, hip, maximal thigh, mid-thigh, maximal calf). Fractional masses from the five-component method were estimated using direct anthropometric measurements [21]. These measurements were summed to obtain a structured mass and a relative mass. Percentages were calculated for each and the difference between structured mass and true body mass was determined. This difference was expressed both in absolute terms and as a percentage of body mass, which gives us information about the margin of error of the model. To obtain a sum of individual tissue masses equal to the actual body mass, this difference was adjusted proportionally to each tissue. In addition, the somatotype components (endomorphism, mesomorphism and ectomorphism) and the sum of six skinfolds were calculated. [22].

For the anthropometric assessment, the Gaucho Pro "Mercosur" kit, manufactured in Argentina under licence from Rosscraft Canada, was used to carry out the anthropometric method in the Americas (except USA, Canada and Mexico). This anthropometric toolkit consists of a long Campbell 20 anthropometer, specifically designed to measure large bone diameters, and a short Campbell 10 anthropometer, used to measure small bone diameters. Both instruments are accurate to 0.5 mm. In addition, a segmometer with an accuracy of 0.01 cm was used to assess lengths, a Lufkin tape measure with an accuracy of 0.01 cm was used to measure perimeters, and a Slimguide plicometer with an accuracy of 0.5 mm was used to measure skinfolds. To determine height and weight, a SECA 700 stadiometer, manufactured in Germany, with an accuracy of 0.1 cm and 0.1 kg respectively, was used.

1.3.2. Years of peak growth velocity (APVC).

Biological maturation was assessed using somatic indicators. The technique proposed by Mirwald et al. [23]. This approach is based on the interaction of anthropometric variables such as weight, height, truncal height and decimal age. The results of the formula showed values at eight different levels (-4, -3, -2, -1, 0, 1, 2, 3). The value zero (0) indicates the time at which the years of peak growth velocity (APVC) occur.

1.3.2. Physical measurements

The physical and agility tests took place in the municipal gymnasium of Collipulli, Araucanía region, Chile, during the morning from 10:00 to 12:00 hours. All participants performed speed tests

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at distances of 5, 10 and 20 metres, as well as the Illinois agility test twice, recording their best time. Before the start of the tests, a 20-minute warm-up was held.

During the intervals between the tests, everyone remained active and performed stretching exercises to avoid cooling down. To assess agility, we used the Illinois test proposed by Raya et al. [24]. Which recorded time digitally using photocells with an accuracy of two decimal places. The Illinois test started from a lying position in pronation and a rapid transition to a standing position was made, followed by multidirectional actions that were constrained by obstacles. Time measurement was performed digitally using Microgate® brand photocells, model Polifemo Radio SF, from Italy. The data were recorded in seconds, with an accuracy of two decimal places.

1.3. Statistical analysis

Statistical analysis was performed using SPSS IBM Corp. version 17.0 statistical software (IBM®, Somers, NY, USA). Descriptive statistics of mean, standard deviation (SD), median, minimum, maximum, first and third quartiles and 95% confidence interval were used. Normal distribution of variables was tested with the Shapiro-Wilk test. The relationship between variables was established with Pearson's correlation coefficient. In addition, a simple linear regression analysis was performed, where the R, R2, standard error of estimate (SEE) and unstandardised coefficient beta (β) were applied for the Illinois agility test, the 5, 10 and 20 m sprint as dependent variables, together with height, body weight, APVC, ∑- folds, GC and somatotype components (endomorphism, mesomorphism and ectomorphism) as independent variables. For all cases, the significance level was $p<0.05$.

Results

Table 1 shows the descriptive characterisation of the study variables, expressed as mean, standard deviation (SD), median, minimum (Min), maximum (Max), first (C25) and third quartile (C75) and confidence interval (CI 95%).

Table 1. Descriptive characterisation of the sample.

Variables (n =19)	Media	DE	Mín	C25	Mediana	C75	Máx.	IC 95%	
								LI	LS
Age (years)	14.0	0.3	13.3	13.9	14.1	14.2	14.4	13.9	14.2
Body Weight (kg)	71.8	9.7	58.8	66.8	70.5	75.5	103.0	67.1	76.5
Size (cm)	181.5	5.8	172.0	178.0	181.0	185.5	195.0	178.7	184.2
APVC (levels)	1.2	0.4	0.5	1.0	1.2	1.6	2.0	1.0	1.4
Triceps brachii fold (mm)	7.9	4.2	1.0	5.0	7.0	8.0	16.0	5.8	9.9
Subscapular fold (mm)	7.6	2.3	5.0	6.0	7.0	9.5	13.0	6.5	8.7
Supraspinal fold (mm)	10.1	5.2	1.0	6.0	9.0	15.0	18.0	7.6	12.6
Abdominal fold (mm)	14.3	7.7	6.0	8.0	13.0	16.0	39.0	10.6	18.0
Anterior thigh fold (mm)	9.2	5.7	1.0	7.0	9.0	13.0	24.0	6.4	12.0
Medial leg crease (mm)	7.4	4.1	1.0	5.0	7.5	8.0	19.0	5.4	9.4
∑folds (mm)	56.9	21.7	33.0	39.0	52.0	63.0	114.0	46.5	67.4
GC (%)	26.7	4.4	19.4	22.0	26.0	30.8	36.0	24.5	28.8
Endomorphism	2.4	1.0	1.2	1.3	2.1	3.2	4.3	1.9	2.8
Mesomorphism	3.0	1.3	0.5	2.1	2.9	4.2	5.0	2.4	3.6
Ectomorphism	3.5	1.1	1.1	2.9	3.7	4.2	5.1	2.9	4.0
Sprint 5 m (s)	1.10	0.09	0.96	1.02	1.10	1.13	1.26	1.06	1.14
Sprint 10 m (s)	1.92	0.12	1.69	1.82	1.92	2.02	2.16	1.85	1.97
Sprint 20 m (s)	3.28	0.35	2.05	3.21	3.28	3.50	3.68	3.10	3.44
Test Illinois (s)	17.63	0.96	16.50	16.94	17.55	18.21	20.32	17.16	18.09

Note: APVC- Peak growth velocity acceleration; BF - Body fat percentage.

Table 2 shows the results for the relationship between the Illinois agility test, the 5, 10 and 20 m sprint with the anthropometric indicators (height and body weight), adiposity (∑-folds, GC), APVC and somatotype (endomorphism, mesomorphism and ectomorphism). A directand positive relationship was observed between the Illinois agility test and the anthropometric indicators of body weight ($r=0.75$; $p<0.01$) and height ($r=0.48$; $p<0.05$), together with the adiposity parameter, ∑ folds ($r=0.71$; $p<0.01$), and an inverse and negative relationship was found with ectomorphism ($r= -0.46$; $p<0.05$). At the same time, there was a direct and positive relationship between endomorphism and the 5 m sprint ($r=0.62$; $p<0.01$) and the 10 m sprint ($r=0.60$; $p<0.01$). On the other hand, the rest of the variables studied did not show statistically significant relationships with the Illinois agility tests, 5 and 10 m sprint ($p>0.05$). Finally, no statistically significant relationships were found between the 20 m sprint and the variables studied ($p>0.05$). Relationship between the Illinois agility test, the 5, 10 and 20 m sprint with anthropometric indicators (height and body weight), adiposity (∑-folds, WC), APVC and somatotype (endomorphism, mesomorphism and ectomorphism).

Table 2. Relationship between the Illinois agility test, the 5, 10 and 20 m sprint with anthropometric indicators (height and body weight), adiposity (∑ skinfolds, BF), APVC and somatotype (Endomorphism, Mesomorphism and Ectomorphism).

Variables (n=19)	Sprint 5 m (s)		Sprint 10 m (s)		Sprint 20 m (s)		Test Illinois (s)	
	r	*p*	r	*p*	r	*p*	r	*p*
Body Weight (kg)	-0.01	1.00	0.12	0.64	0.01	0.95	0.75**	0.01
Size (cm)	-0.10	0.68	0.16	0.53	0.09	0.71	0.48*	0.04
APVC (levels)	-0.12	0.61	-0.02	0.93	-0.11	0.65	0.29	0.23
∑folds (mm)	0.38	0.11	0.39	0.10	0.07	0.77	0.71**	0.01
GC (%)	0.31	0.19	0.43	0.07	0.22	0.34	0.33	0.16
Endomorphism	0.62**	0.01	0.60**	0.01	0.07	0.78	0.36	0.13
Mesomorphism	0.29	0.23	0.16	0.52	-0.22	0.37	0.04	0.88
Ectomorphism	-0.12	0.64	-0.04	0.87	0.07	0.78	-0.46*	0.05

* the correlation is significant at the <0.05 level ** The correlation is significant at the <0.01 level; Nota: APVC-Pico de aceleración de velocidad de crecimiento; GC-Porcentaje de grasa corporal.

Table 3 shows the linear regression values for the Illinois agility test, the 5 and 10 m sprint with anthropometric indicators (height and body weight), adiposity (∑-folds, WC), APVC and somatotype (endomorphism, mesomorphism and ectomorphism). It is observed that the Illinois agility test is better associated with body weight and ∑ folds ($R2$ =55% and 50%, respectively). On the other hand, both the 5 m and 10 m sprint show better association with endomorphism ($R2$ =38% and 36% respectively). For the other anthropometric variables, adiposity, APVC, mesomorphism and endomorphism, a low explanatory power is observed.

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Table 3. Linear regression for the Illinois agility test, the 5 and 10 m sprint with anthropometric indicators (height and body weight), adiposity (∑ skinfolds, BF), APVC and somatotype (Endomorphism, Mesomorphism and Ectomorphism).

Variables (n=19)	Sprint 5 m (s)						Sprint 10 m (s)						Test Illinois (s)					
					Coefficients not standardized						Coefficients not standardized						Coefficients not standardized	
	R	R^2	EEE	*p*	*Constante*	*b*	R	R^2	EEE	*p*	*Constante*	*b*	R	R^2	EEE	*p*	*Constante*	*b*
Body Weight (kg)	0.01	0.01	0.09	1.00	1.10	-6.723	0.12	0.01	0.13	0.64	1.81	0.001	0.75	0.55	0.18	0.01	12.33	0.074
Size (cm)	0.10	0.01	0.09	0.68	1.39	-0.002	0.16	0.02	0.12	0.53	1.32	0.003	0.48	0.23	0.87	0.04	3.02	0.081
APVC (levels)	0.12	0.02	0.09	0.61	1.13	-0.028	0.02	0.01	0.13	0.93	1.92	-0.01	0.29	0.09	0.95	0.23	16.76	0.718
∑folds (mm)	0.38	0.14	0.08	0.11	1.01	0.002	0.39	0.15	0.12	0.10	1.79	0.002	0.71	0.50	0.20	0.01	15.83	0.032
GC (%)	0.31	0.10	0.09	0.19	0.94	0.006	0.43	0.18	0.11	0.07	1.60	0.012	0.34	0.11	0.93	0.16	15.69	0.073
Endomorphism	0.62	0.38	0.07	0.01	0.97	0.056	0.60	0.36	0.10	0.01	1.74	0.075	0.36	0.13	0.93	0.13	16.79	0.351
Mesomorphism	0.29	0.08	0.09	0.23	1.04	0.020	0.16	0.02	0.12	0.52	1.87	0.015	0.04	0.01	0.99	0.88	17.54	0.027
Ectomorphism	0.12	0.01	0.09	0.64	1.13	-0.009	0.04	0.01	0.13	0.87	1.93	-0.005	0.46	0.21	0.88	0.05	19.05	-0.413

Note: APVC- Peak growth velocity acceleration; GC-Percentage of body fat.

4. Discussion

The aim of this study was to analyse the relationship of sprinting and agility with body composition, adiposity and somatotype in young Chilean basketball players. In terms of height, an average of 181.5 ± 5.8 cm was found, higher values when compared to Serbian U-16 players who have an average of 174.3 ± 7.5 cm [25], but smaller compared to Spanish U-14 players with 189.2 ± 5.6 cm [26]. In basketball, a relationship has been established between height and performance in terms of defence and dribbling skills in European players from U-10 to U-17 categories [27]. This is of great importance, as taller stature implies longer arms, which can favour in-game performance [26]. In addition, identifying basketball players by height and body weight is one of the simplest and most effective ways to identify them [28]. Regarding the physical variables, the results obtained indicated that the 5 and 10 metre sprint is mostly related to endomorphism ($r=0.62$; $p<0.01$ and $r=0.60$; $p<0.01$), respectively, not so with the rest of the body composition variables, and the 20 metre sprint. When comparing the 5,10 and 20-metre results, we found similar results to those reported by Sánchez-Díaz et al. [29], with U-14 players of the Spanish Basketball Club Association (ACB) 1.12± 0.1; 2.0±0.1; 3.46±0.4, respectively. It has been observed that performing explosive movements, either in a straight line or with changes of direction, at a higher speed is related to an increase in the strength and power of the lower extremities in basketball players. [30]. The above results support that having excess body fat is associated with difficulties in short-distance explosive movements in basketball players, which is particularly relevant in the 5-20 metre sprint [31]. For example, this has been noted as a significant indicator in the performance of young tennis players, as it limits their ability to move quickly and position themselves effectively on the court to hit the ball and control the game [32]. Regarding the Illinois agility test, a direct and positive relationship was observed with the anthropometric indicators of body weight ($r=0.75$; $p<0.01$) and height ($r=0.48$; $p<0.05$), together with the adiposity parameter, ∑ folds ($r=0.71$; $p<0.01$). These results are in agreement with previous studies, such as Papla et al. [33] who have found that there is a strong correlation between maximal muscle strength in abduction and adduction and performance in the agility test. This is especially relevant when performing the first

 doi:10.20944/preprints202501.1551.v1

turn in the non- dominant direction during this test. Furthermore, Delextrat et al. [34], suggest that straight- line and unilateral horizontal sprint tests should be implemented to assess elite youth players. Notwithstanding the importance of agility and speed in basketball, these are the least studied variables [34]. The level of biological maturity (APVC) had a low explanatory power on the anthropometric, adiposity, mesomorphism and endomorphism variables and the 5, 10 and 20 metre sprint. This is inconsistent with previous studies in U-14 and U-16 male basketball players, where no significant association was found between biological maturity and physical performance in the repeated sprint and sprint tests [35]. These differences can be explained by the observation in several studies that, during early adolescence, around the age of 13-14 years, somatic maturation has a more significant effect on physical performance. However, as young people reach 15-16 years of age, the influence of somatic maturation diminishes. In addition, there are a number of internal and external factors that affect biological maturation, which can influence the speed and intensity of development, as well as its impact on body composition and physical performance in young athletes [36,37,38,39].

According to research conducted by Guimarães et al. [40] and Bonal et al. [41] concluded that maturity status

is the most influential factor in physical performance tests. It was also found that the years of training have a significant impact on the technical skills tests. That is, while physical performance is directly related to maturity status, technical skills are more influenced by training time. The limitations of the study were based on the exclusion of additional players based on their strategic position in the game. For further research, it would be advisable to expand the sample size, including a greater diversity of ages and developing a more detailed profile of the Chilean U-14 basketball player. However, the strength of the research is to provide current data according to the age of these athletes, offering a solid basis for future studies and the implementation of specific training programmes that consider these aspects in the improvement of the physical capacity and sporting performance of young Chilean basketball players.

5. Conclusion

This study reveals a significant relationship between body composition, especially indicators of adiposity (∑-folds and endomorphism), and the physical abilities of sprinting and agility in young Chilean basketball players. These findings highlight the importance of considering body composition when assessing and training young basketball players, which may have significant implications for their optimal performance and development.

Conflict of interest: The authors declare no conflict of interest.

Author Contributions: Conceptualization, M.C.-B., C.H.-M and C.M-B.; methodology, M.C.-B; P.D-F.; validation, F.C-N; formal analysis, M.C.-B., C.H.-M.; review and editing,J.A-G.,P.V-M and M.C.-B.; visualization, H.C-Q, J.A-G. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Review Board Statement: This study was conducted in accordance with the Declaraton of Helsinki and approved by the committee of the Adventist University of Chile, (code 2021-40).

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