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HORIZONTAL JUMP PROFILE AND RELATIONSHIP WITH SPRINT SPEED AND ANTHROPOMETRIC VARIABLES IN YOUTH BASKETBALL PLAYERS

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PERFIL SALTO HORIZONTAL Y SU RELACIÓN CON LA RAPIDEZ Y VARIABLES ANTROPOMÉTRICAS EN BALONCESTISTAS JUVENILES

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Abstract

Objective: To evaluate the effect of arm swing on horizontal jump performance and its relationship with height, weight, and speed in youth basketball players. Methods: Ten male players (13.7 ± 0.8 years) performed the horizontal jump without arms (SLSI-sb), with arms (SLSI-cb), and a 20-m sprint test. Height and weight were measured. Paired t-tests and Spearman correlations were used. Results: The SLSI-cb (216.7 ± 16.5 cm) was significantly greater than the SLSI-sb (185.4 ± 14.2 cm), with a mean increase of 31.3 cm ($p = 0.002$; $d = 2.01$). Height correlated positively with SLSI-cb ($\rho = 0.67$; $p = 0.033$), but not with SLSI-sb ($\rho = 0.47$; $p = 0.172$). Both jump modalities correlated significantly with each other ($\rho = 0.64$; $p = 0.045$), indicating a shared explosive strength foundation. No significant correlations were found between jumping (with or without arms) and 20-m speed (SLSI-sb: $\rho = -0.21$; $p = 0.56$; SLSI-cb: $\rho = -0.33$; $p = 0.35$). Body weight showed no significant correlation with any variable ($p > 0.05$ in all cases). Conclusion: Arm swing significantly increases horizontal jump performance in youth basketball players, with a very large effect size (d = 2.01). Height is associated with performance only when arm swing is allowed, suggesting taller players better exploit this technique. Speed and horizontal jump are independent abilities, so they should be trained separately. Evaluating both jump modalities in formative basketball is recommended to obtain a comprehensive explosive profile and identify possible deficits in upper-body force transfer.

Keywords: Standing long jump, arm swing, sprint speed, anthropometry, youth basketball.

Resumen

Objetivo: Evaluar el efecto del impulso de brazos en el salto horizontal y su relación con talla, peso y rapidez en baloncestistas juveniles. Métodos: Participaron 10 varones (13.7 ± 0.8 años). Realizaron salto horizontal sin brazos (SLSI-sb), con brazos (SLSI-cb) y test de 20 m. Se registraron talla y peso. Se aplicó prueba t pareada y correlaciones de Spearman. Resultados: El SLSI-cb (216.7 ± 16.5 cm) superó significativamente al SLSI-sb (185.4 ± 14.2 cm), con un incremento de 31.3 cm ($p = 0.002$; $d = 2.01$). La talla correlacionó positivamente con el SLSI-cb ($\rho = 0.67$; $p = 0.033$), pero no con el SLSI-sb ($\rho = 0.47$; $p = 0.172$). Ambas modalidades de salto mostraron correlación significativa entre sí ($\rho = 0.64$; $p = 0.045$), indicando una base común de fuerza explosiva. No hubo correlaciones significativas entre el salto (con o sin brazos) y la rapidez en 20 m (SLSI-sb: $\rho = -0.21$; $p = 0.56$; SLSI-cb: $\rho = -0.33$; $p = 0.35$). El peso no mostró relación con ninguna variable ($p > 0.05$). Conclusión: El impulso de brazos mejora notablemente el salto horizontal en juveniles, con un efecto muy grande ($d = 2.01$). La talla solo se asocia al rendimiento cuando se permite el braceo, lo que sugiere que los jugadores más altos aprovechan mejor esta técnica. La rapidez y el salto horizontal son capacidades independientes, por lo que deben entrenarse por separado. Se recomienda evaluar ambas modalidades en baloncesto formativo para obtener un perfil completo de la explosividad y detectar déficits en la transferencia de fuerza del tren superior.

Palabras clave: Salto horizontal, impulso de brazos, rapidez, antropometría, baloncesto juvenil.

Introduction

Basketball is characterized as an intermittent sport with high physical demands, in which tactical, technical, and conditional elements converge within a defined playing area. Among the physical capacities that are essential for athletic performance in youth categories, explosive lower limb strength and short-distance acceleration stand out.

Actions such as vertical and horizontal jumps, along with rapid movements between 5 and 20 meters, are frequent motor skills in competition (Pedro-Múñez et al., 2025a; de Pedro-Múñez et al., 2025b). Historically, the assessment of explosive strength in the discipline of basketball has focused essentially on the vertical jump, using tests such as the Squat Jump (SJ) and the Countermovement Jump (CMJ), which make it possible to measure the power generated by the lower body under different neuromuscular activation conditions (Bosco et al., 1983).

Recent studies, including the meta-analysis by Ramirez-Campillo et al. (2022), continue to support the countermovement jump (CMJ) as a reliable instrument for monitoring neuromuscular adaptations in basketball players. However, in recent years, the standing long jump has gained greater importance as a complementary assessment tool, mainly because its execution more closely resembles game-like movements, such as forward movements to finish a play near the basket or explosive defensive actions (Zhou et al., 2020).

The standing long jump can be performed in two ways: with or without the active participation of the arms. The arm swing facilitates the transfer of both linear and angular momentum during the takeoff phase, which translates into an increase in the distance achieved (Lees et al., 2004; Ashby & Heegaard, 2002).

Regarding young populations, the narrative review by Zhou et al. (2020) suggest that arm swing increases the speed of the center of gravity at the moment of takeoff, a situation explained primarily by the so-called "energy transfer theory." However, a large percentage of this research has been applied to athletes in track and field or general team sports, reflecting the fact that the available evidence specifically for youth basketball players remains limited.

Likewise, the association between linear speed and horizontal jump has been studied in various sports, yielding results that do not always coincide. While some research identifies links between these two qualities, other studies focused on young populations indicate that speed at these ages is determined more by neuromuscular aspects (such as stride frequency and coordination between muscle groups) and running technique than by maximum explosive power (Delecluse, 1997; Peterson et al., 2006).

Along these lines, de Pedro-Múñez et al. (2025b) indicate that jump and sprint tests are reliable and valid instruments for evaluating neuromuscular performance in basketball players, although they caution that the relationship between these two abilities does not necessarily translate into direct transfer.

Furthermore, anthropometric variables, including height and body weight, can influence performance during the horizontal jump. In basketball, height is an influential factor, particularly in youth categories, where variability between individuals is considerable due to different rates of biological maturation (Malina et al., 2004). Recent studies indicate that anthropometric development, particularly lower limb length, directly affects jump performance (Jawabreh et al., 2025; Rinaldo et al., 2020). In this regard, taller players may gain advantages associated with greater body leverage during the arm swing phase, while a high percentage of body fat could negatively affect performance in both sprints and jumps (Jawabreh et al., 2025). However, the available evidence regarding these relationships in young basketball players is still limited.

Against this background, it is important to characterize the horizontal jump profile in youth basketball players, taking into account the effect of arm swing, as well as analyzing its relationship with linear speed and essential anthropometric variables. This characterization would contribute to improving sports evaluation processes and guiding training more precisely, especially during the developmental stages, where individualization is essential.

Consequently, this study sets out the following objectives:

1) To compare horizontal jump performance with and without arm swing in youth basketball players.

2) To examine the correlation between both jump modalities and 20-meter sprint speed.

3) To determine the association between horizontal jump and anthropometric variables such as height and body weight. It is hypothesized that arm swing will generate a significant increase in horizontal jump, that height will show a positive correlation with the jump performed with arm swing, and that no correlation will be identified between horizontal jump and linear speed.

Metodology

A cross-sectional, descriptive, and correlational observational study was conducted. All assessments were performed in a single morning session (between 9:00 and 11:00 AM) at a temperature of 22-24°C and relative humidity of 50-60%. This study complied with the ethical guidelines of the Declaration of Helsinki and received approval from the institution's ethics committee. All basketball players and their legal guardians signed informed consent forms.

Participants

A group of ten basketball players, part of the Holguín provincial pre-selection team for the national event, voluntarily participated in the research.

Inclusion Criteria:

- Be between 13 and 15 years old
- Be on the pre-selection team and train at least three times a week (90-120 minutes per session)
- Have not suffered any musculoskeletal injuries in the last three months

Exclusion criteria:

- Have suffered any acute injury in the last four weeks
- Not have completed all the tests for any reason.

The descriptive characteristics of the basketball players are shown in Table 1.

Table 1.

Anthropometric and performance characteristics of the basketball players (n=10).

Variable	Mean ± SD	Range
Age (años)	13.7 ± 0.8	13.0 – 15.0
Height (cm)	173.5 ± 7.2	163.0 – 185.0
Weight (kg)	62.3 ± 8.1	52.0 – 78.0
BMI (kg/m²)	20.7 ± 1.9	18.2 – 24.1
SLSI-sb (cm)	185.4 ± 14.2	165.0 – 208.0
SLSI-cb (cm)	216.7 ± 16.5	195.0 – 242.0
Speed 20 m (s)	3.25 ± 0.18	3.02 – 3.58
Note: SD standard deviation; SLSI-sb: standing long jump; SLSI-cb: standing long jump		

Procedures

All basketball players carried out a 15-minute uniform warm-up that consisted of: 5 minutes of continuous running at low intensity, 5 minutes of dynamic stretching (leg swings, strides, and skipping), and 3 submaximal horizontal jumps (at 50%, 70%, and 90% of subjective effort) with 30-second rests between each jump. This warm-up protocol is in accordance with the suggestions of recent research on neuromuscular preparation in youth groups (de Pedro-Múñez et al., 2025; Ferioli et al., 2025). After warming up, the basketball players took a 3-minute break before beginning the tests.

Anthropometry

Height was recorded using a portable stadiometer, ensuring that the basketball players were barefoot, in contact with the wall and their heads aligned with the Frankfurt plane. Weight was measured on a digital scale. Body Mass Index (BMI) was calculated by dividing weight (kg) by height in meters squared (m^2). Recent studies favorably suggest complementing these measurements with body composition indicators (Jawabreh et al., 2025; Rinaldo et al., 2020).

Horizontal jump test without arm impulse (SLSI-sb)

Standing horizontal jump test without arm swing (SLSI-sb): Following protocols by Ortega et al. (2018) and adjustments by De Pedro-Múñez et al. (2025), the participant stood behind a line with feet shoulder-width apart and hands on their hips. They bent their knees to a chosen angle and jumped horizontally without any additional countermovement, landing on both feet simultaneously. The distance was measured from the line to the mark of the rearmost heel. Three valid attempts were performed with 60 seconds of rest between them, and the best jump was recorded. A jump was invalidated if it involved touching the line, landing asymmetrically, placing the hands on the ground, or losing balance.

Horizontal jump test with arm swing (SLSI-cb)

Horizontal jump test with arm swing (SLSI-cb): Same protocol, but with free arm movement backward during flexion and forward during extension, allowing them to be raised above the head (Zhou et al., 2020; Ramirez-Campillo et al., 2020). Three valid attempts were performed with a 60-second rest period, and the best result was recorded.

20 m Speed Test

Linear acceleration capacity from a stationary start was measured. Time was recorded using two handheld timers (Casio HS-70W) positioned at the finish line, with a "ready, go" signal. Two attempts were performed with a 3-minute rest period, and the average of the best attempt times was recorded. Synchronization between timekeepers was verified with a prior trial, yielding an intraclass correlation coefficient (ICC) greater than 0.90 (De Pedro-Múñez et al., 2025).).

Statistical Analysis

Data are presented as mean ± SD and range. The Shapiro-Wilk test was used to verify normality. A paired Student's t-test was used to compare SLSI-sb and SLSI-cb, and Cohen's d was used to calculate the effect size. For the correlations between height, weight, SLSI-sb, SLSI-cb and 20 m speed, Spearman's rank correlation coefficient (ρ) was used, which is robust for small samples and outliers (Jawabreh et al., 2025). The significance level was set at $p < 0.05$..

Results

Correlations between variables

Spearman's rank correlation coefficients (ρ) for all variables can be found in Table 2.

Table 2.

Spearman's rank correlation matrix (ρ) between anthropometric, jump, and speed variables (n = 10).

Variable 1 2 3 4 5

Variables	1	2	3	4	5
Height	----	----	----	----	----
Weight	0.78*	----	----	----	----
SLSI-sb	0.47	0.35	----	----	----
SLSI-cb	0.67*	0.41	0.64*	----	----
20 m Speed	-0.29	-0.18	-0.21	-0.33	----

Note: $p < 0.05$. SLSI-sb: horizontal jump without arm impulse; SLSI-cb: horizontal jump with arm impulse.

The most relevant findings were:

1. Height with SLSI-cb: Positive and significant correlation (ρ = 0.67; p = 0.033). Taller players tended to achieve greater distances in the arm swing jump. This finding is consistent with recent studies reporting that anthropometric development influences jump performance in young basketball players (Rinaldo et al., 2020; Jawabreh et al., 2025).

2. Height with SLSI-sb: No significant correlation was found (ρ = 0.47; p = 0.172). This suggests that, in the absence of arm swing, height is not a determining factor in performance.

3. SLSI-sb with SLSI-cb: Positive and significant correlation (ρ = 0.64; p = 0.045). Both modalities share a common base of lower body explosive strength, as reported in previous research (de Pedro-Múñez et al., 2025a; de Pedro-Múñez et al., 2025b).

4. Jump speed: No significant correlations were found between 20-m speed and any jump modality (SLSI-sb: ρ = -0.21; p = 0.56; SLSI-cb: ρ = -0.33; p = 0.35). Although the correlations were negative (greater jump, shorter time), they did not reach statistical significance. This result is consistent with studies in youth populations that suggest both abilities are relatively independent (Rinaldo et al., 2020; Jawabreh et al., 2025).

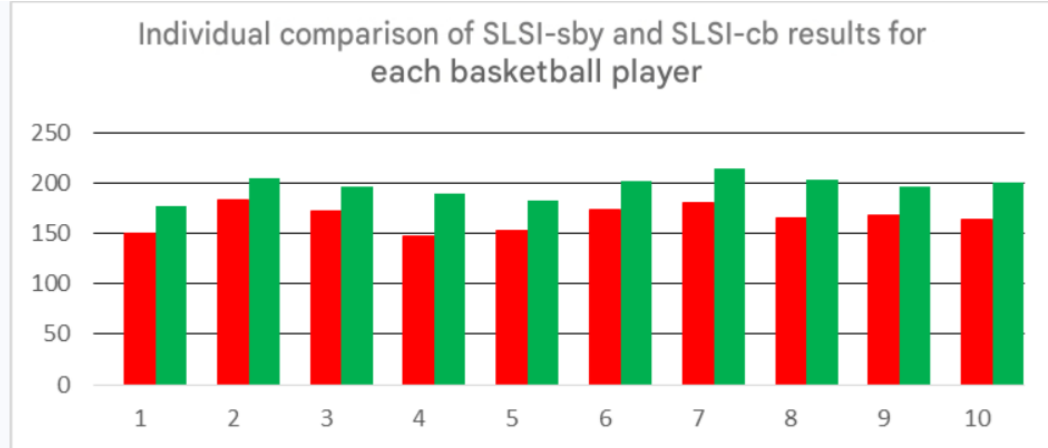
5. Correlations with weight: Weight did not correlate significantly with any variable ($p > 0.05$ in all cases). This could be because total weight is not a good predictor of performance at this age, and body composition may be a more relevant factor (Rinaldo et al., 2020).

Graphical Analysis

This presents an individual comparison of the SLSI-sb and SLSI-cb results for each basketball player. It can be seen that all players improved when using their arms, with individual increases ranging from 22 to 42 cm. A trend is also observed: players with a higher SLSI-sb score also achieved a higher SLSI-cb score, reflecting the positive relationship between the two modalities.

Figure 1.

Comparison of the horizontal jump without the use of arms (SLSI-sb) and with arms (SLSI-cb).



Discussion

The most relevant finding was that arm swing significantly increased horizontal jump by 31.3 cm (d = 2.01), an improvement of 15-20%. This is consistent with the review by Zhou et al. (2020), which describes how arm swing increases the velocity of the center of gravity at takeoff. The magnitude of the effect is comparable to the improvements reported in meta-analyses of plyometric training (Ramirez-Campillo et al., 2020). Biomechanically, arm swing provides linear and angular momentum and activates the hip and knee extensors through the myotatic reflex (Lees et al., 2004; Ashby and Heegaard, 2002). In young people, who are still refining their technique, the potential for improvement is high. The practical implication is clear: evaluating both modalities offers a more detailed profile, isolating lower body strength (without arm swing) and assessing the specific movement (with arm swing). The difference between the two could be an indicator of the efficiency of upper-to-lower body force transfer.

Height showed a positive and significant correlation only with the SLSI-cb. This suggests that taller players, who typically have longer arms, generate greater angular momentum during arm swing. Physically, although longer arms require more force to accelerate, once in motion they produce more momentum (Ashby and Heegaard, 2002). This result aligns with Rinaldo et al. (2020) and Jawabreh et al. (2025), who point out that anthropometric and maturational variables are key to performance in young people.

The lack of correlation between height and SLSI-sb indicates that, without arm swing, other variables such as relative strength or technique are more decisive. Body weight did not correlate significantly with any variable, which could indicate that total weight is not a good indicator of active muscle mass at this stage. Body composition (lean mass vs. fat mass) is probably a more relevant predictor of performance (Rinaldo et al., 2020).

No significant relationship was found between horizontal jump and 20-meter speed. This finding coincides with studies in young people that suggest these abilities are relatively independent during developmental stages (Peterson et al., 2006), although it contrasts with correlations found in adults (Loturco et al., 2015).

Several reasons explain this discrepancy:

1) In adolescents (13-15 years), speed depends more on neuromuscular factors and running

technique than on maximum explosive strength (Delecluse, 1997).

2) The 20-m test measures linear acceleration with an alternating movement pattern, while the horizontal jump is a distinct bilateral movement. Specificity limits transfer (Young et al., 2001; Ferioli et al., 2025).

3) The implication for training is that the horizontal jump and linear speed must be trained specifically, without assuming a direct transfer between them.

The positive correlation between SLSI-sb and SLSI-cb ($\rho = 0.64$; $p = 0.045$) confirms that they share a base of explosive lower-limb strength. However, since it is not a perfect correlation, it reinforces the idea that the technical factor of arm swing and upper-body strength transfer explain a significant and unique portion of the variance in performance. Joint assessment allows for a more precise diagnosis for individualized training..

Conclusions

1. Arm swing significantly increases horizontal jump distance in youth basketball players, with an average increase of 31.3 cm and a very large effect size ($d = 2.01$), highlighting the importance of proper technique in this sport.

2. Height is positively associated with horizontal jump distance only when arm swing is permitted ($\rho = 0.67$; $p = 0.033$), indicating that taller players benefit more from this technique.

3. No significant relationship was found between horizontal jump distance (with or without arm swing) and 20-meter sprint speed, suggesting that these are relatively independent abilities in this population and require differentiated and specific training.

4. It is recommended to evaluate both horizontal jump modalities in youth basketball to obtain a complete profile of explosive power and detect potential deficits in upper-to-lower body strength transfer.

5. Explosive strength training should include exercises that integrate arm coordination, especially in taller players, without neglecting the specific development of linear acceleration technique..

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