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Influence of segmental length on bilateral horizontal and vertical jumping performance of untrained collegiate students

Influencia de la longitud segmentaria en el rendimiento de los saltos horizontales y verticales bilaterales en estudiantes universitarios no entrenados

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Abstract

This study investigated the influence of segmental lengths—foot, lower leg, upper leg, leg, arm span, and torso height—on bilateral horizontal and vertical jumping performance. Data from 136 PathFit 1 students at Bulacan State University (AY 2024-2025) were analyzed using a quantitative predictive design. Fitness tests, including BMI, Standing Long Jump, Vertical Jump, and segmental measurements, were conducted with validated instruments, and multiple linear regression (SPSS v30) assessed predictors of jumping performance. For the Standing Long Jump, significant R^2 values included right foot length (0.137), left foot length (0.124), right arm span (0.336), left arm span (0.317), and torso span (0.270). For the Vertical Jump, significant R^2 values included right foot length (0.141), left foot length (0.127), and right lower leg length (0.110). Results identified foot lengths, lower leg lengths, ankle-to-hip lengths, and arm spans as significant predictors for both jump types, while upper leg lengths were insignificant, and torso height was significant only for horizontal jumps. Limitations included the exclusion of foot girth, lower leg and upper leg dimensions, and upper body girth. Future research should include girth, volume, and segmental variations to better understand their role in jumping performance.

Keywords: anthropometric measurements, limb length, vertical jump, horizontal jump.

Resumen

El estudio investigó cómo la longitud segmentaria (pie, pierna inferior, muslo, pierna completa, envergadura de brazos y altura del torso) influye en el rendimiento de los saltos horizontales y verticales bilaterales en 136 estudiantes de PathFit 1 de la Universidad Estatal de Bulacán, seleccionados por muestreo aleatorio en el Año Académico 2024-2025. Se realizaron pruebas de IMC, salto de longitud y salto vertical, y las mediciones se analizaron con regresión lineal múltiple mediante SPSS v.30 para identificar predictores significativos. En el salto de longitud, los valores R^2 más altos fueron: envergadura del brazo derecho (0.336), envergadura del brazo izquierdo (0.317) y longitud del torso (0.270). En el salto vertical, destacaron la longitud del pie derecho (0.141), la longitud del pie izquierdo (0.127) y la pierna inferior derecha (0.110). Las longitudes de los pies, piernas inferiores y envergaduras de brazos fueron predictores significativos en ambos tipos de salto, mientras que la longitud de los muslos no fue relevante. La altura del torso predijo el salto horizontal, pero no el vertical. El estudio sugiere que investigaciones futuras consideren más mediciones como perímetros y volúmenes para entender mejor el impacto de las características antropométricas en el rendimiento en saltos.

Palabras clave: mediciones antropométricas, longitud de extremidades, salto vertical, salto horizontal.

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Introduction

Jumping, defined as the propulsion of the body through the forceful extension of the lower extremities (Yang, 2009; Masagca, 2025b), is essential for both athletic performance and overall health. In sports like basketball, volleyball, and track and field, superior jumping ability enhances performance in sprints, hurdles, and long jump events, emphasizing its role in athletic success (Bobbert, 1990; Kobal et al., 2017). Jumping also improves aerobic and anaerobic capacity, critical for endurance and explosive movements (Hudgins et al., 2013). Beyond athletics, horizontal and vertical jumping performance correlates with physical fitness markers such as body composition, muscular strength, and cardiorespiratory endurance (Tomkinson et al., 2021; Hart, 2018; Tounsi et al., 2015) and is even linked to better academic outcomes (Del Pozo et al., 2017). Additionally, jumping ability is relevant for special populations, such as visually impaired youth (Pennell et al., 2021), and trained athletes benefit from neuromuscular adaptations that significantly improve performance (Zaggelidis et al., 2012). Thus, jumping is a crucial skill for enhancing athleticism and maintaining a Healthy lifestyle for all individuals

On upper extremities, the research underscores the critical role of arm span length and upper limb movement in athletic performance, particularly in jumping. Arm swings significantly enhance jump height by increasing the work done by the lower extremities, with notable improvements observed when arm swings are employed versus not (Hara et al., 2006; Masagca, 2024a). The contribution of upper limbs to ground reaction force is substantial, particularly just before takeoff, leading to increased vertical jump height (Lees et al., 2004; Mosier et al., 2019). Among collegiate athletes, arm span predicts countermovement jump performance (Karadenizli et al., 2023) and correlates with athleticism metrics, including plyometric movements like sprinting, in basketball and water polo players (Čović et al., 2023; Keiner et al., 2020). In summary, arm span length and upper limb dynamics are vital for enhancing jumping performance and other athletic abilities across sports.

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On the lower extremities, numerous studies highlight the influence of lower limb dimensions on bilateral jumping performance, emphasizing foot, lower leg, and upper leg length s as key predictors. Foot length directly impacts jumping ability, with smaller foot and toe lengths predicting higher jump performance in women (Hawley et al., 2020), while in men, foot length predicts vertical jump displacement (Davis et al., 2006). Longer lateral heel lengths and toes improve performance in both sexes (Van Werkhoven and Piazza, 2017). Lower leg length reliably predicts vertical jump performance among athletes (Maity et al., 2018), correlates with flight time in countermovement jumps (Babu and Thapa, 2024), and is linked to peak power in standing long jumps (Mann et al., 2021). Upper leg length influences vertical jump performance in both sexes (Daugherty et al., 2021) and predicts power output and jump outcomes among various populations (Ciplak et al., 2020). Studies consistently highlight the importance of leg length in athletic performance across diverse sports, with significant correlations to leg muscle power and high jump ability (Risnawati & Jusrianto, 2020) and long jump results among students (Ardison & Rahmadani, 2024). In speed-based sports, longer legs correlate with improved short-distance running performance, with a notable correlation value of 0.6801, due to enhanced movement angles (Kriswanto et al., 2021). Additionally, leg length is linked to peak power in standing long jumps (Kriswanto et al., 2021) and is moderately positively correlated with countermovement jump metrics such as flight time and velocity (Babu & Thapa, 2024).

Lastly, torso height is not a significant predictor of vertical bilateral jumping performance on the core. Studies on long jumpers found no notable effect of body height, including torso height, on performance, while body weight showed an inverse relationship with jump outcomes, emphasizing the importance of optimal weight management (Pavlović et al., 2023). Training and muscle strength play more critical roles, with plyometric training significantly improving vertical jump performance, especially in female athletes (Stojanović et al., 2017; Masagca, 2024b). Movement mechanics, such as hip power and knee angular velocity, also strongly influence jump height (Shinchi et al., 2024). While anthropometric measures like body height

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moderately predict jumping performance in elite junior athletes, they are not strong standalone predictors (Ugarkovic et al., 2002; Masagca, 2025a).

Despite extensive research on jumping performance and segmental lengths, several limitations remain. First, most studies primarily focused on trained athletes, leaving a gap in understanding how lower limb dimensions influence jumping ability in untrained populations. Without examining these variables in non-athletes, the findings remain incomplete in capturing a broader spectrum of individuals. Secondly, while vertical jump performance has been thoroughly investigated, there is a noticeable lack of research on horizontal jump performance, limiting insights into how segmental lengths contribute to different types of jumps. Lastly, although arm swing has been established as a key factor in enhancing jump height, the specific influence of arm segment length on jumping performance has not been explored. These gaps emphasize the need for further studies to comprehensively assess the impact of segmental length on both horizontal and vertical jumping performance across diverse populations.

Lower limb dimensions, such as foot, lower leg, and upper leg length s, significantly influence jumping performance, with longer legs enhancing power, mechanics, and athletic outcomes. Arm span also boosts jump height through arm swing mechanics, while torso height has minimal impact. Ultimately, training, strength, and biomechanics are more critical than body dimensions in determining athletic performance. Several gaps emerged in the studies of jumping performance and segmental length. Research has primarily focused on trained athletes, leaving untrained populations underexplored. While vertical jump performance has been extensively studied, there is limited research on horizontal jump performance. Additionally, although arm swing is known to enhance jumping, the specific influence of arm segment length on jump performance remains unexamined.. With these gaps, the aim of the study was to investigated the influence of segmental length such as foot length, lower leg length, upper leg length , leg length, arm span, and torso height on both horizontal and vertical jumping performance. Hypotheses were formed with the related studies as bases.

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Hypothesis

H_1 Length of the feet, upper legs, lower legs and legs (both right and left) directly influences bilateral vertical and horizontal jumping performance.

H_2 Arm span (both right and left) directly influences bilateral vertical and horizontal jumping performance.

H_3 Torso span directly influences bilateral vertical and horizontal jumping performance.

Methodology

Research Design

The study utilized quantitative research, as the variables were assessed using tools that produce numerical data. Furthermore, predictive analysis was employed to explore the relationship between segmental lengths—specifically foot length, lower leg length, upper leg length , leg length, arm span, and torso height—and their impact on both horizontal and vertical jumping performance in bilateral jumps.

Sampling and participants

The respondents in the study comprised students enrolled in the Physical Activity Towards Health and Fitness 1 course for the Academic Year 2024-2025, specifically during the first semester, with selection criteria designed to ensure a homogeneous sample with similar academic backgrounds and physical activity exposure. Only officially enrolled first-year, first-semester students from Bulacan State University were included to maintain consistency in educational experiences, while those from additional campuses and students retaking the course due to previous failures were excluded to prevent variability in fitness levels and prior knowledge. These criteria were chosen to allow for more controlled comparisons and to reduce potential confounding variables. The study employed simple random sampling to enhance objectivity, and respondents retained the right to withdraw at any point, ensuring ethical research practices. A total of 136 individuals participated, providing a sample that represents first-year students in *PatHFit 1*; however, the findings may not be fully generalizable to students from other year levels, programs, or campuses. Future research could expand the sample to improve the applicability of the results across a broader student demographic. Table 1 presents the demographic profile of the respondents. The

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demographic profile reveals that the mean age is 18.327 ± 0.585 years for females, 18.448 ± 0.739 years for males, and 18.397 ± 0.689 years overall. Mean height is 157.866 ± 5.314 cm for females, 169.611 ± 5.934 cm for males, and 165.326 ± 8.026 cm overall. Mean weight is 52.463 ± 11.258 kg for females, 63.576 ± 12.258 kg for males, and 59.488 ± 13.038 kg overall. BMI averages 20.969 ± 11.258 for females, 22.038 ± 12.258 for males, and 21.635 ± 3.815 overall.

Table 1. Demographic Profile of the respondents

	Female	Male	All
Age	18.327±.585	18.448±.739	18.397±.689
Height	157.866±5.314	169.611±5.934	165.326±8.026
Weight	52.463±11.258	63.576±12.258	59.488±13.038
Body Mass Index	20.969±11.258	22.038±12.258	21.635±3.815

Research Instrument

Body Mass Index (BMI)

Body Mass Index (BMI) serves as a common measure to categorize individuals according to the relationship between their weight (in kilograms) and the square of their height (in meters) (Hainer & Hainerová, 2012; Masagca, 2025c). To determine BMI, first weigh the individual on a scale and measure their height against a wall. Then, use the formula: BMI = weight (kg) / [height (m)]². Although BMI serves as a practical and dependable measure for determining weight status, its effectiveness is constrained since it overlooks important elements such as muscle mass and fat distribution, which are essential for a comprehensive assessment of overall health. Studies confirm that BMI correlates well with body fat percentage across diverse populations, including Black populations in Nigeria, Jamaica, and the U.S., as well as children and adolescents, though regional and age-specific variations necessitate cautious interpretation (Luke et al., 1997; Pietrobelli et al., 1998).

Standing Long jump test

The Standing Long Jump Test serves as a reliable and effective assessment of leg power, where individuals are tasked with jumping forward as far as they can from a stationary stance (Thomas et al., 2020). The individual begins with their feet positioned shoulder-width apart, engages in an arm swing, bends their knees, and propels

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themselves forward, while the distance from the starting line to the closest heel is measured. The assessment demonstrates exceptional reliability, featuring intraclass correlation coefficients of 0.96 for male raters and 0.99 for female raters, alongside test-retest reliability scores of r = 0.96 for males and r = 0.90 for females (Rahman, 2021). Furthermore, the assessment proficiently differentiates between the horizontal jumping capabilities of top-tier and non-top-tier athletes.

Vertical jump test

The vertical jump test (Klavora, 2000) was employed to assess bilateral vertical jumping performance. This primarily evaluates the strength of the lower limbs in executing concurrent extension of the hip, knee, and ankle joints (Vanezis & Lees, 2005). A vertical jump assessment was conducted utilizing the jump and reach technique. The procedure involves the participant indicating their maximum standing reach on a wall, followed by a jump to achieve the highest possible mark. The vertical jump height is assessed by measuring the distance between the two marks, with the test conducted three times to ensure precision. The approach was selected due to its practicality. Nonetheless, the integrity of the testing remained intact, as the method demonstrated a strong correlation with the motion analysis system (r=.906) (Menzel et al., 2010).

Segmental length measurement

The measurement of the foot length, lower leg length, upper leg length , leg length, arm span, and torso height was carried out using iBayam Soft Ruler, a tape measure. The point of measurement of the said segments was presented in Table 2.

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Table 2. Segments points of measurements

Segment	Point of Measurement
Foot Length	From the posterior-most point of the heel to the anterior-most point of the toes (usually the tip of the big toe)
Lower Leg Length	From the inferior border of the knee joint (tibial plateau) to the most distal point of the ankle (lateral malleolus)
Upper leg length	From the superior border of the hip joint (greater trochanter of the femur) to the inferior border of the knee joint (tibial plateau)
Leg Length	From the superior border of the hip joint (greater trochanter of the femur) to the most distal point of the ankle (lateral malleolus)
Arm Span	From the tip of the middle finger on one hand to the tip of the middle finger on the opposite hand, with arms fully extended horizontally
Torso Height	From the base of the neck (cervical vertebra C7) to the base of the spine or the iliac crest of the pelvis

Data Gathering

The data gathering commenced with the ethical clearance from the College of Sports, Exercise and Recreation Local Research Ethics Committee. The respondents' fitness data on their PathFit 1 course were gathered. These include testing results of the Body Mass Index (BMI), Standing long Jump, and Vertical Jump test. After this, data was analyzed. Error in measurement was minimized as the procedures for quantifying BMI and jumping performance were the same across all PathFit 1 courses.

Data Analysis

Multiple linear regression analysis was employed to examine whether segmental lengths served as predictors of jumping performance. This method was chosen to assess the predictive relationship between specific body segments and jumping outcomes. Multiple linear regression relies on key assumptions such as normality of residuals, homoscedasticity, independence of observations, and the absence of multicollinearity. However, no formal diagnostic tests were conducted to verify these assumptions. Nevertheless, the Central Limit Theorem (CLT) provides theoretical support, as it states that with a sufficiently large sample size, the distribution of residuals tends to approximate normality regardless of the population distribution. Given the sample size in this study, it is reasonable to assume that the normality assumption is likely met. However, other assumptions such as homoscedasticity and multicollinearity remain

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unverified, which should be considered when interpreting the results. Data analysis was performed using SPSS version 30.

Potential Ethical Issues

The study underwent evaluation and received approval from the Local In-House Ethics Committee at Bulacan State University, specifically within the College of Sport, Exercise, and Recreation, ensuring adherence to ethical guidelines for human research. In alignment with the Helsinki Declaration, which emphasizes the principles of informed consent, participant welfare, and data confidentiality, the study prioritized ethical considerations throughout the research process. After receiving ethical clearance, authorization was granted by the College's research coordinator to initiate data collection. Respondents were subsequently contacted to obtain their informed consent, ensuring that they voluntarily participated with full awareness of the study's purpose, risks, and benefits. Consistent with the Helsinki Declaration's principle of transparency, participants were assured that they could obtain their results, and that access could be granted to the administration of the study location upon request. Furthermore, it was emphasized that all gathered data would be handled with strict confidentiality, protecting the privacy and rights of all participants, as outlined in international ethical research standards.

Results

Table 3. presented segmental length measurements for females, males, and the combined sample. Mean and standard deviation were used as statistical analyses. The right foot length is 21.876 ± 2.211 cm for females, 24.380 ± 2.342 cm for males, and 23.489 ± 2.585 cm for the combined sample. Similarly, the left foot length measures 21.967 ± 2.199 cm for females, 24.336 ± 2.371 cm for males, and 23.493 ± 2.569 cm for the combined group. The right lower leg length is 36.354 ± 3.905 cm for females, 40.370 ± 4.855 cm for males, and 38.924 ± 4.910 cm for the combined sample, while the left lower leg length is 36.568 ± 3.892 cm for females, 40.280 ± 4.815 cm for males, and 38.951 ± 4.827 cm overall. The measurements for the right upper leg are 32.561 ±

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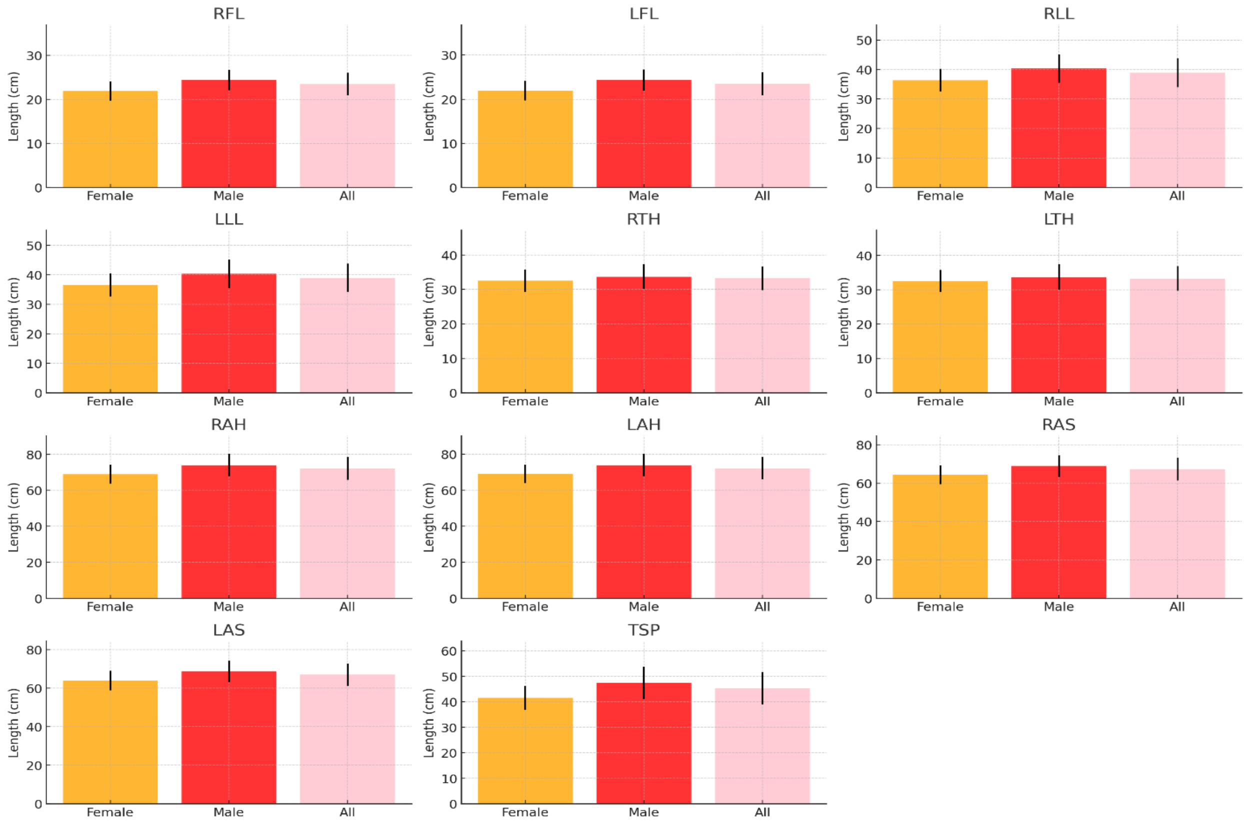
3.192 cm for females, 33.654 ± 3.572 cm for males, and 33.251 ± 3.469 cm for the combined group, whereas the left upper leg measures 32.597 ± 3.207 cm for females, 33.689 ± 3.698 cm for males, and 33.300 ± 3.555 cm for all participants. For the right arm to hip length, the measurements are 68.915 ± 5.206 cm for females, 74.024 ± 6.283 cm for males, and 72.175 ± 6.383 cm for the combined group. The left arm to hip length is 69.165 ± 5.178 cm for females, 73.969 ± 6.327 cm for males, and 72.251 ± 6.349 cm for all participants. The right arm span measures 64.194 ± 4.842 cm for females, 68.886 ± 5.674 cm for males, and 67.179 ± 5.823 cm overall, while the left arm span is 64.102 ± 5.043 cm for females, 68.705 ± 5.634 cm for males, and 67.031 ± 5.842 cm for the combined sample. Finally, the torso span is measured as 41.541 ± 4.716 cm for females, 47.397 ± 6.303 cm for males, and 45.300 ± 6.407 cm for the overall group

Table 3. Segmental length measurements



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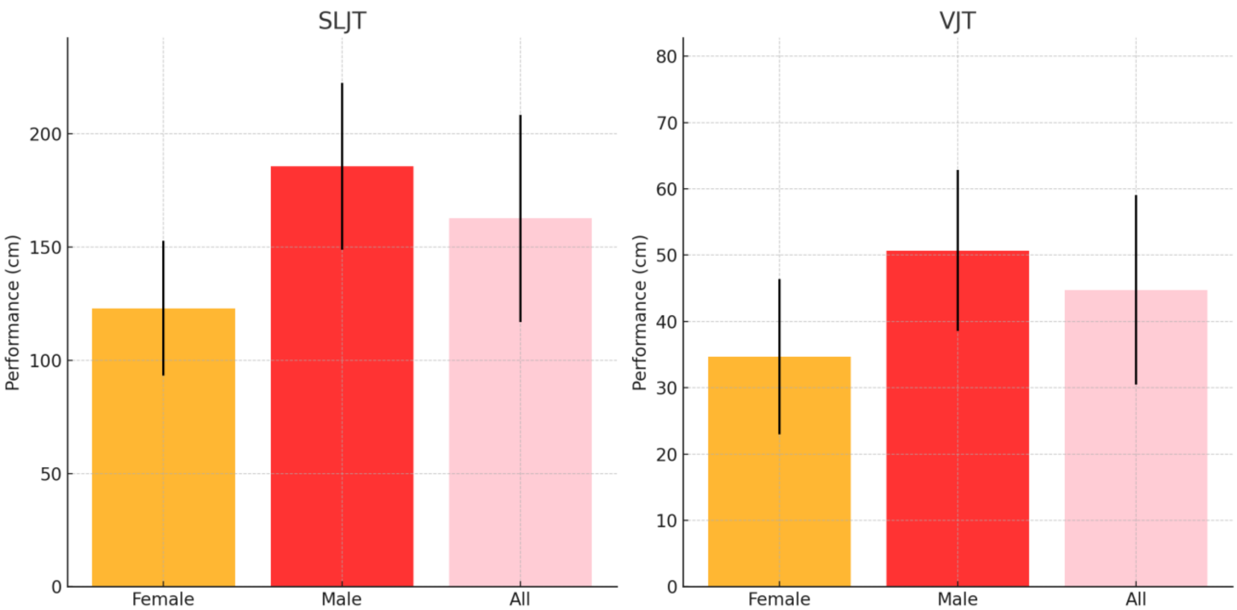
	Female	Male	All
RFL	21.876 ± 2.211	24.380 ± 2.342	23.489 ± 2.585
LFL	21.967 ± 2.199	24.336 ± 2.371	23.493 ± 2.569
RLL	36.354 ± 3.905	40.370 ± 4.855	38.924 ± 4.910
LLL	36.568 ± 3.892	40.280 ± 4.815	38.951 ± 4.827
RUL	32.561 ± 3.192	33.654 ± 3.572	33.251 ± 3.469
LUL	32.597 ± 3.207	33.689 ± 3.698	33.300 ± 3.555
RAH	68.915 ± 5.206	74.024 ± 6.283	72.175 ± 6.383
LAH	69.165 ± 5.178	73.969 ± 6.327	72.251 ± 6.349
RAS	64.194 ± 4.842	68.886 ± 5.674	67.179 ± 5.823
LAS	64.102 ± 5.043	68.705 ± 5.634	67.031 ± 5.842
TSP	41.541 ± 4.716	47.397 ± 6.303	45.300 ± 6.407

Note: RFL = Right Foot Length; LFL = Left Foot Length; RLL = Right Lower Leg; LLL = Left Lower Leg; RUL = Right Upper Leg; LUL = Left Upper Leg; RAH = Right Arm to Hip; LAH = Left Arm to Hip; RAS = Right Arm Span; LAS = Left Arm Span; TSP = Torso Span

In Table 4. the bilateral jumping performance was presented. Mean and standard deviation was used on this analysis. For the standing long jump test, females recorded a mean of 122.990 ± 29.739 cm, males achieved 185.656 ± 36.908 cm, and the combined sample scored 162.738 ± 45.778 cm. In the vertical jump test, females had a mean performance of 34.7 ± 11.725 cm, males reached 50.690 ± 12.137 cm, and the combined sample achieved 44.772 ± 14.302 cm.

Table 4. Bilateral jumping performance



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	Female	Male	All
SLJT	122.990±29.739	185.656±36.908	162.738±45.778
VJT	34.7±11.725	50.690±12.137	44.772±14.302

Note: SLJT= Standing Long Jump Test; VJT= Vertical Jump Test

In Table 5, horizontal bilateral jumping performance and various anthropometric measurements were analyzed using multiple linear regression analysis to assess their predictive capability. H_1 was accepted, as the analysis showed that Right Foot Length significantly predicted the Standing Long Jump Test, explaining 13.7% of the variance ($R^2 = .137$, $F = 21.387$, $p < .001$). Similarly, Left Foot Length significantly predicted the Standing Long Jump Test, accounting for 12.4% of the variance ($R^2 = .124$, $F = 19.036$, $p < .001$). Right Lower Leg was also a significant predictor, explaining 9.0% of the variance ($R^2 = .090$, $F = 13.297$, $p < .001$), and Left Lower Leg contributed 7.2% of the variance ($R^2 = .072$, $F = 11.088$, $p = .001$), leading to the acceptance of these predictors. However, Right Upper Leg and Left Upper Leg did not significantly predict the Standing Long Jump Test, with $R^2 = .011$ ($F = 1.446$, $p = .231$) and $R^2 = .010$ ($F = 1.375$, $p = .243$), respectively. With this, H_1 was rejected. Additionally, Right Ankle to Hip significantly predicted the Standing Long Jump Test, explaining 8.2% of the variance ($R^2 = .082$, $F = 12.054$, $p < .001$), and Left Ankle to Hip contributed 7.1% of the variance ($R^2 = .071$, $F = 10.256$, $p = .002$), leading to the acceptance of H_1. H_2 was accepted, as Right Arm Span significantly predicted the Standing Long Jump Test, explaining 33.6% of the variance ($R^2 = .336$, $F = 17.142$, $p < .001$), while Left Arm Span was also a significant predictor, accounting for 31.7% of the variance ($R^2 = .317$, $F = 15.077$, $p < .001$). Lastly, H_3 was rejected, as Torso Span did not significantly predict the Standing Long Jump Test, despite explaining 27.0% of the variance ($R^2 = .270$, $F = 10.574$, $p = .001$).

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Table 5. Multiple linear regression analysis between various anthropometric measurements and horizontal bilateral jumping performance

Hypothesis		**Beta Coefficient**	***R^2***	***F***	***t*-value**	***p*-value**	**Decision**
H_1	RFL→SLJT	6.549	.137	21.387	4.625	<.001	Accepted
	LFL→SLJT	6.265	.124	19.036	4.363	<.001	Accepted
	RLL→SLJT	2.792	.090	13.297	3.647	<.001	Accepted
	LLL→SLJT	2.612	.072	11.088	3.330	.001	Accepted
	RUL→SLJT	1.359	.011	1.446	1.203	.231	Rejected
	LUL→SLJT	1.293	.010	1.375	1.173	.243	Rejected
	RAH→SLJT	2.053	.082	12.054	3.472	<.001	Accepted
	LAH→SLJT	1.916	.071	10.256	3.202	.002	Accepted
H_2	RAS→SLJT	2.639	.336	17.142	4.140	<.001	Accepted
	LAS→SLJT	2.473	.317	15.077	3.883	<.001	Accepted
H_3	TSP→SLJT	1.926	.270	10.574	3.252	.001	Rejected

Note: RFL = Right Foot Length; LFL = Left Foot Length; RLL = Right Lower Leg; LLL = Left Lower Leg; RUL = Right Upper Leg ; LUL = Left Upper Leg ; RAH = Right Ankle to Hip; LAH = Left Ankle to Hip; RAS = Right Arm Span; LAS = Left Arm Span; TSP = Torso Span; SLJT= Standing Long Jump Test

As for the vertical bilateral jumping performance, the results of the multiple linear regression analysis indicate the relationships between various predictors and the Vertical Jump Test, as presented in Table 6. H_1 was accepted as the analysis showed that Right Foot Length significantly predicted the Vertical Jump Test, explaining 14.1% of the variance ($R^2 = .141$, $F = 22.204$, $p < .001$). Similarly, Left Foot Length significantly predicted the Vertical Jump Test, explaining 12.7% of the variance ($R^2 = .127$, $F = 19.603$, $p < .001$). Right Lower Leg was also a significant predictor, accounting for 11.0% of the variance ($R^2 = .110$, $F = 16.763$, $p < .001$), and Left Lower Leg contributed 10.0% of the variance ($R^2 = .100$, $F = 15.022$, $p < .001$), leading to the acceptance of these predictors. However, Right Upper Leg and Left Upper Leg did not significantly predict the Vertical Jump Test, with $R^2 = .110$ ($F = 2.582$, $p = .110$) and $R^2 = .015$ ($F = 2.031$, $p = .156$), respectively. With this, H_1 was rejected. Additionally, Right Ankle to Hip significantly predicted the Vertical Jump Test, explaining 10.9% of the variance (R^2

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= .109, F = 16.511, p < .001), and Left Ankle to Hip contributed 9.5% of the variance (R^2 = .095, F = 14.228, p < .001), leading to the acceptance H_1. H_2 was accepted as Right Arm Span significantly predicted the Vertical Jump Test, explaining 8.1% of the variance (R^2 = .081, F = 11.844, p < .001), while Left Arm Span was also a significant predictor, accounting for 7.7% of the variance (R^2 = .077, F = 11.203, p = .001). Lastly, H_3 was accepted, as Torso Span significantly predicted the Vertical Jump Test, accounting for only 2.3% of the variance (R^2 = .023, F = 3.181, p = .077).

Table 6. Multiple linear regression analysis between various anthropometric measurements and vertical bilateral jumping performance

Hypothesis		Beta Coefficient	R^2	*F*	*t*-value	*p*-value	Decision
H_1	RFL→VJT	2.079	.141	22.204	4.712	<.001	Accepted
	LFL→VJT	1.983	.127	19.603	4.428	<.001	Accepted
	RLL→VJT	.968	.110	16.763	4.094	<.001	Accepted
	LLL→VJT	.937	.100	15.022	3.876	<.001	Accepted
	RUL→VJT	.565	.110	2.582	1.607	.110	Rejected
	LUL→VJT	.490	.015	2.031	1.425	.156	Rejected
	RAH→VJT	.740	.109	16.511	4.063	<.001	Accepted
	LAH→VJT	.696	.095	14.228	3.772	<.001	Accepted
H_2	RAS→VJT	.698	.081	11.844	3.442	<.001	Accepted
	LAS→VJT	.675	.077	11.203	3.347	.001	Accepted
H_3	TSP→VJT	.339	.023	3.181	1.784	.077	Accepted

Note: RFL = Right Foot Length; LFL = Left Foot Length; RLL = Right Lower Leg; LLL = Left Lower Leg; RUL = Right Upper Leg ; LUL = Left Upper Leg ; RAH = Right Ankle to Hip; LAH = Left Ankle to Hip; RAS = Right Arm Span; LAS = Left Arm Span; TSP = Torso Span; VJT= Vertical Jump Test

Discussion

Foot, lower leg, and upper leg length influence jumping performance

The study confirmed that right and left foot lengths significantly predict bilateral vertical and horizontal jumping performance, supporting H_1. Foot length and structure are crucial for jump performance, with specific dimensions linked to higher jump

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performance in women (Hawley et al., 2020) and foot length predicting vertical jump displacement in men (Davis et al., 2006). Longer lateral heel lengths and toes improve jump efficiency through better mechanical leverage (van Werkhoven & Piazza, 2017). Additionally, longer feet enhance the engagement of muscle-tendon units like the Achilles tendon, optimizing elastic energy storage and release for explosive movements(Foster et al.,2021). While foot length is a valuable metric for athletic talent identification, future research should explore additional dimensions, such as foot area and volume, for a more comprehensive understanding.

Furthermore, the study identified right and left lower leg lengths as significant predictors of vertical and horizontal jumping performance, also supporting H_1. Lower leg length reliably predicts vertical jump performance (Maity et al., 2018) and correlates with enhanced performance in volleyball players and high/long jumpers (Singh & Khan, 2014; Asfaw & Pallavi, 2018). It also correlates moderately with countermovement jump flight time (Babu & Thapa, 2024) and is linked to peak power in standing long jumps (Mann et al., 2021). Mechanically, longer lower legs enhance torque at the ankle and knee joints, improving propulsion and stride length in horizontal jumps (Singh & Khan, 2014; Mann et al., 2021). These findings suggest lower leg length as a key metric for talent identification in jumping sports, though future research should explore additional dimensions like girth and volume for a fuller understanding.

Lastly, the study found right and Left Upper Leg lengths to be insignificant predictors of vertical and horizontal jumping performance, leading to the rejection of H_1. This contrasts with previous research showing upper leg length as a predictor of resisted vertical jump performance due to its influence on torque and power generation during takeoff (Daugherty et al., 2021). Among handball athletes, upper leg length has been positively associated with double-feet and left-foot vertical jumps (Ciplak et al., 2020) and significantly contributes to long and triple jump performance (Halaweh & Hammouri, 2008). Efficient jumping performance depends on the proportionality of upper leg , lower leg, and overall limb length to optimize lever systems, which may explain the lesser impact of isolated upper leg length in this study (Daugherty et al., 2021). Tendons, such as the Achilles tendon, which are critical for elastic energy storage

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and release, may play a more dominant role in explosive jumps (Halaweh & Hammouri, 2008). Future studies should examine additional upper leg measurements, focusing on muscularity in the posterior and anterior regions, to better understand their role in athletic performance.

Ankle to hip length influence on jumping performance

The study found right and left ankle-to-hip lengths to be significant predictors of vertical and horizontal jumping performance, supporting H_1. This aligns with research linking leg length and muscle power to high jump ability (Risnawati & Jusrianto, 2020), improved long jump results (Ardison & Rahmadani, 2024), and short-distance running speed through increased movement range .Also, it correlates with peak power in standing long jumps (Kriswanto et al., 2021) and countermovement jump performance (Babu & Thapa, 2024; Masagca, 2025d). Biomechanically, longer ankle-to-hip lengths improve leverage and torque generation at the hip, enhancing force application during takeoff (Winter, 2009). Longer limbs also optimize the force-length relationship of muscles like the hip and knee extensors, boosting jump propulsion (Zajac, 1989). The combination of lower leg and upper leg length s is a strong predictor of jumping performance, but future research should examine other segmental height combinations, including foot length, for a more comprehensive understanding.

Arm span, and torso height on jumping performance

The study identified right and left arm spans as significant predictors of vertical and horizontal jumping performance, supporting H2. Arm swings significantly enhance jump height by increasing lower extremity work and ground reaction force production (Hare et al., 2006; Lees et al., 2004; Moister et al., 2019). Arm span has been linked to countermovement jump performance in collegiate athletes (Karadenizli et al., 2023) and correlates with athletic attributes such as fat percentage, lean muscle mass, and skinfold thickness in basketball players (Čović et al., 2023). It also predicts plyometric activities like sprinting in water polo players (Keiner et al., 2020). Biomechanically, a larger arm span increases angular displacement, enhances force application (Bobbert et al., 1996), and optimizes the kinetic chain for efficient energy transfer (Harman et al., 1990).

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Additionally, longer arms improve control of the center of mass, aiding efficient jump execution. While arm span is a useful metric for evaluating athletic potential, future research should explore additional measurements, such as upper arm, forearm, and shoulder girth, to better understand their role in performance.

The study found torso height to be a significant predictor of bilateral horizontal jumping performance but not vertical jumping performance, resulting in the rejection of H_3 and acceptance of H_3. Previous research shows mixed results: body height, including torso height, did not significantly influence long jump performance, though body weight inversely impacted results (Pavlović et al., 2023). Conversely, training and muscle strength improve vertical jump performance more than static measures like torso height (Stojanović et al., 2017). Biomechanical factors, such as hip power and knee angular velocity, also correlate strongly with vertical jump performance (Shinchi et al., 2024). In horizontal jumping, a taller torso positions the center of mass advantageously for forward propulsion, enhancing force application and momentum transfer (Lees et al., 2004). It also increases the moment of inertia about the hip, aiding torque production and energy transfer (Harman et al., 1990). Conversely, vertical jumping relies on lower limb power and symmetrical force production, where torso height plays a stabilizing rather than active role (Bobbert et al., 1996; Harman et al., 1990). However, it is crucial to acknowledge that the absence of additional anthropometric measurements, such as foot area, limb volume, and axial dimensions of the torso, may have influenced these findings. Without accounting for these factors, caution should be exercised when generalizing the results, as they do not provide a fully comprehensive view of how body dimensions impact jumping performance. Future research should integrate a broader set of anthropometric variables to refine the understanding of torso height's role in jumping mechanics and athletic performance.

Conclusion

The study evaluated segmental measurements as predictors of bilateral vertical and horizontal jumping performance. Significant predictors for both types of jumps included right and left foot lengths, lower leg lengths, ankle-to-hip lengths, and arm spans, while upper leg lengths were insignificant. Torso height was a significant

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predictor of horizontal jumping but not vertical jumping. Metrics like foot length, lower leg length, arm span, and the combination of lower leg and upper leg lengths are valuable for talent identification in jump-focused sports. Torso height's utility is sport-specific, aiding horizontal but not vertical jumps. Limitations included the exclusion of additional measurements, such as foot girth, lower leg dimensions, and upper leg characteristics beyond length. Arm span was assessed without upper arm, forearm, or shoulder girth, and torso height excluded axial body girth. Future research should include girth, volume, and segmental variations to provide a more comprehensive understanding of their influence on jumping performance.

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