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DEVELOPMENT AND VALIDATION OF AN ANTHROPOMETRIC-BASED TALENT IDENTIFICATION TEST FOR EARLY VOLLEYBALL ATHLETES AGED 6–9 YEARS

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ABSTRACT

Early identification of sport talent is vital for systematic athlete development and long-term success. However, validated tools for detecting early volleyball talent are scarce, especially for children aged 6–9 years. This study developed and validated the Early Volleyball Anthropometric Talent Test (EVATT-6/9) as a reliable and practical instrument based on anthropometric indicators. Using a research and development (R&D) design with a mixed-methods approach, 90 students (45 boys, 45 girls) from three elementary schools in Pekanbaru, Indonesia, were tested on seven indicators: body height, arm span, standing reach, leg length, upper-arm circumference, hand length, and calf circumference. Analyses included Aiken's V, Exploratory and Confirmatory Factor Analyses, and reliability tests (Cronbach's α, ICC). All indicators showed strong content validity (Aiken's $V > 0.90$) and excellent reliability ($\alpha = 0.87$; ICC = 0.89). Two latent factors—upper-body reach/control and lower-body power/support—explained 72.4% of variance, and criterion validity was confirmed ($r = 0.68$, $p < 0.01$). EVATT-6/9 is valid, reliable, and practical for early volleyball talent identification in school and grassroots settings.

Keywords: volleyball, anthropometry, early talent identification, children aged 6–9 years.

INTRODUCTION

In the formative years of childhood, sport participation offers not only health and psychosocial benefits but also a unique window for cultivating athletic talent through structured initiation and early detection of potential. (Beldman & al., 2025). The global emphasis on early athlete development, embodied in frameworks such as the Long-Term Athlete Development (LTAD) model, underscores the importance of identifying and guiding prospective athletes well before adolescence. However, despite the widespread application of talent identification (TID) practices across sports, there remains a striking gap in validated, sport-specific instruments for children aged 6 to 9 years. In the team-sport discipline of volleyball—where success depends on a blend of anthropometric characteristics (e.g., height, reach), motor and physical capacities, technical-tactical skills, and psychological readiness—the entry point for talent detection is often delayed to later childhood or adolescence. (de la Rubia et al., 2025). For children aged 6-9 years, this represents a missed opportunity to align physical growth trajectories with sport-specific development pathways early.

In volleyball, anthropometric traits such as body height, arm span, and jumping reach have been repeatedly associated with talent and performance in junior and senior players (e.g., height

and spike reach differentiate selected vs. non-selected youth players) (De la Rosa et al., 2025). More recently, a scoping review of talent research in volleyball found that 62.8% of studies used anthropometric measures and 56.4% used physical-motor characteristics, but only 20.5% adopted a multidimensional, predictive approach (Mishaal Faihan, 2025). These findings underscore that, while anthropometry is a significant component of volleyball talent research, the evidence base remains skewed toward older age groups, cross-sectional designs, and non-validated instruments.

From a practical perspective, early detection of volleyball talent in children aged 6–9 years offers several advantages. At this age range, children are in a "critical period" for developing fundamental movement skills, coordination, and gross motor competence—which serve as the foundation for later sport-specific technical skills and physical capacities. As highlighted by Pavlovic et al., (2024)"talent detection … is typically conducted in elementary school, typically between the ages of eight and ten," and often uses generic anthropometric and motor test batteries rather than sport-specific ones. However, the majority of test batteries employed at young ages are generic (e.g., motor coordination, fitness) and not specifically calibrated to the demands of volleyball. In the sport ecosystem, this means that children with early anthropometric or movement potential for volleyball are either overlooked or misdirected into non-optimal pathways.

Despite the acknowledged role of anthropometric profiling in volleyball talent identification, key issues persist. Firstly, many existing instruments were developed for adolescent or adult athletes, not for pre-pubescent children aged 6–9. Secondly, even when anthropometric and motor variables are measured, the instruments often lack rigorous validation for younger age cohorts, including content validity, construct validity, and reliability. Thirdly, there is limited longitudinal or predictive research linking early anthropometric profiles at such young ages with later performance in volleyball. For example, William & Mekoulou, (2024)In a study of junior track & field athletes, it was concluded that anthropometric measures «rarely differed» between regional and national squad groups, suggesting limited discriminative power in isolation. Taken together, these gaps indicate that the current landscape of talent identification for early-age volleyball remains under-researched and lacks practical, validated tools.

Given this context, the specific problem this research addresses is the absence of a validated, anthropometric-based instrument to detect potential volleyball talent in children aged 6 to 9 years. In many national sport systems, selection or scouting for volleyball begins at much older ages, by which time growth- and maturation-related biases may already have influenced the trajectory of athlete development. For younger children, the lack of a bespoke test tailored for

volleyball means that the earliest phase of the athlete development pathway is under-equipped with evidence-based screening tools. Without such tools, coaches and educators may rely on ad hoc or unsystematic scouting, risking missing children with promising anthropometric and motor profiles suitable for volleyball specialization.

From a scientific and practical standpoint, the urgency for this research is evident. On the scientific level, building and validating such an instrument contributes to the literature on early talent detection, anthropometric profiling, and sport-specific measurement models in youth sport. On the applied level, it supports practitioners (coaches, physical education teachers, talent scouts) with a rigorously constructed and validated test that can be deployed at the grassroots level—particularly important in countries seeking to strengthen their competitive base through early athlete identification. (Sgrò & al., 2024). Moreover, because anthropometric maturity and growth patterns vary widely in early childhood, an instrument designed for ages 6-9 can help mitigate selection biases associated with the relative-age effect and maturational differences. (de Oliveira & al., 2024). Accordingly, the present study aligns with the broader strategic aims of high-performance sport systems to widen the talent base and cultivate early pipelines of young volleyball athletes.

The overarching aim of the study is thus twofold: (1) to develop an anthropometric-based talent identification test tailored for early-age volleyball athletes (aged 6–9 years), and (2) to validate this test in terms of content validity (via expert review), construct validity (via factor analysis) and reliability (via internal consistency and test–retest analysis). By achieving these objectives, the research seeks to deliver a practical measurement instrument and accompanying normative data/reference values to inform early-age talent screening in volleyball programs. Moreover, the outcome is expected to provide a model framework that other sports may adapt for early talent identification.

In reviewing prior literature on volleyball and talent identification, the body of work is substantial but concentrated on older age groups. For instance, a scoping review by Podstawski et al. (2025) reported that only 11.5% of studies adopted longitudinal or retrospective designs, and even fewer focused on children younger than 12 years. Further, Panggraita et al. (2023) emphasised that anthropometry and maturation are significant for identifying talented volleyball players, but again in adolescent samples. Maciejewski & Bobula (2025) similarly noted that most test batteries used with children aged 6–9 are generic and not sport-specific, advocating the development of sport-specific instruments. Additionally, a study of children aged 7–12 in Indonesia found that anthropometry did not significantly differ between children who participated in sports clubs and those who did not, yet motor coordination and physical

performance did—implying that anthropometry alone may not suffice for discrimination at a young age (de la Rubia et al., 2025). This body of evidence reinforces the need for a more refined instrument combining anthropometry with sport-specific relevance, targeted at the early childhood age band.

The gap analysis therefore, highlights four interrelated deficiencies in the current literature and practice: (a) lack of validated tools for early-age (6–9 years) volleyball talent identification based on anthropometry; (b) predominant reliance on cross-sectional and older-age group studies, limiting early detection strategies; (c) insufficient sport-specific instruments, with many studies using generic batteries unsuited to volleyball'svolleyball's physical-technical demands; (d) scarcity of normative reference data and factor-validated models for youngest age groups. Addressing these gaps, the current study contributes by developing and validating a test that is both age-appropriate and volleyball-specific in its anthropometric focus, thereby extending the research horizon into an underrepresented cohort of prospective athletes.

The novelty and justification of this research are thus apparent. First, to our knowledge, this study is among the first to target the 6–9-year age band in volleyball talent identification using an anthropometric-based instrument. Second, by embedding rigorous validation procedures (content/expert review, exploratory and confirmatory factor analysis, reliability testing), the study elevates the measurement standard in the field—moving beyond descriptive profiling to instrument development. Third, the practical implications are significant: nations and clubs seeking to establish early talent pathways in volleyball will benefit from an empirically grounded tool that aligns with longitudinal development frameworks such as LTAD. Finally, the study may spark similar early-age, sport-specific talent detection research across other team sports, thereby expanding the talent identification literature beyond its traditional adolescent focus.

In sum, this introduction has (i) positioned the study within the broader context of early talent development and volleyball sport science, (ii) articulated the specific problem of lacking validated early-age instruments, (iii) outlined the urgency and practical significance of addressing this problem, (iv) specified the research aim and objectives, (v) located the study within the extant literature and identified key gaps, and (vi) clarified the novelty and anticipated contribution of the research. The subsequent sections will present the methodological design for the development and validation of the test instrument, followed by results, discussion, and implications for both theory and practice.

METHODOLOGY

This study employed a research and development (R&D) design grounded in a mixed-methods sequential approach, integrating both qualitative and quantitative validation procedures

to ensure the scientific rigor and applicability of the developed instrument. The principal aim of this design was to develop and validate an anthropometric-based talent identification test specifically tailored for early-age volleyball athletes aged 6 to 9 years. The research followed the systematic steps proposed by Borg and Gall (1983) for educational product development, adapted to the context of sport measurement and talent identification. Accordingly, the study proceeded through four structured stages: (1) needs analysis and theoretical model formulation, (2) initial test development and item generation, (3) expert validation and pilot testing, and (4) field testing accompanied by psychometric evaluation and model refinement.

In the first stage, qualitative methods—including literature synthesis and expert interviews—were used to identify the theoretical basis and relevant anthropometric indicators that underpin volleyball talent identification at early ages. The subsequent stages were quantitatively oriented, involving statistical validation procedures such as content validity index (CVI), Aiken's V coefficient, exploratory factor analysis (EFA), and confirmatory factor analysis (CFA) to ensure both construct validity and reliability of the developed test. The mixed design provided a comprehensive process—beginning with conceptual development, progressing through empirical validation, and culminating in practical implementation—ensuring that the resulting instrument would be theoretically grounded, psychometrically sound, and applicable for practitioners in school and grassroots sports contexts.

This developmental framework was selected because instrument creation in sport science requires iterative cycles of refinement and empirical testing to achieve measurement precision, ecological validity, and feasibility in real-world contexts. Thus, combining expert-based qualitative judgment with quantitative psychometric evaluation allowed the research to capture both the conceptual integrity of anthropometric constructs and their empirical measurement performance. In alignment with the standards of scale development in sport and physical performance research (Hameed, 2025)This R&D design was deemed the most appropriate methodological approach for developing a valid and reliable anthropometric-based talent identification instrument for early volleyball athletes.

This study involved 90 elementary school students aged 6 to 9 years from three public schools in Pekanbaru, Indonesia. This age group was chosen because it represents a crucial stage for identifying early motor and anthropometric characteristics related to sports potential and long-term athlete development. Participants were selected using purposive sampling based on the following criteria: they were physically healthy, enrolled in regular physical education classes, had no prior volleyball experience, and had obtained parental consent. This ensured that the

measurements reflected natural physical potential rather than learned sport skills, consistent with the principle of early talent detection (Ali et al., 2024).

The sample included 45 boys and 45 girls, allowing for comparison of gender-based anthropometric differences commonly found in prepubertal children. Participants came from varied socio-economic backgrounds typical of urban schools in Pekanbaru, offering a realistic representation of children's physical characteristics at this developmental stage. All measurements were conducted during school hours, assisted by physical education teachers and health staff, after providing a full explanation of the study's aims, procedures, and ethical guidelines to both parents and students.

In summary, the selected participants effectively represented the study's target population and provided a solid foundation for developing and validating the Early Volleyball Anthropometric Talent Test (EVATT-6/9). Their involvement enabled the identification of key growth patterns relevant to early volleyball performance, supporting the creation of a valid and practical tool for use in school-based and early sport talent development programs.

Table 1. Research Instrument and Analytical Description of EVATT-6/9

No	Indicator	Measurement Method / Tool	Rationale and Analytical Description	Expected Relationship to Volleyball Talent
1	Body Height (cm)	Measured using a stadiometer, the participant stands erect without shoes	Height is a foundational anthropometric parameter strongly linked to success in volleyball, particularly in spiking and blocking performance. Taller players generally possess biomechanical advantages in reach and net control.	Higher body height predicts greater reach, net dominance, and blocking potential.
2	Arm Span (cm)	Fingertip-to-fingertip distance measured with flexible anthropometric tape	Arm span reflects upper-limb leverage and coordination potential. Studies indicate strong correlations between arm span and spike/block efficiency in youth volleyball.	Wider arm span enhances lateral coverage, blocking surface, and spiking reach.
3	Standing Reach (cm)	Vertical reach is measured with one arm fully extended upward against a wall.	Standing reach integrates total body height and limb length, serving as a direct indicator of potential jump-reach height. It is a practical proxy for assessing volleyball-specific reach ability.	Higher reach correlates with greater ability to perform spikes and defensive blocks.
4	Leg Length (cm)	Distance from the anterior superior iliac spine to the medial malleolus measured with	Leg length contributes to stride efficiency, jumping power, and mechanical leverage during vertical propulsion. It is associated with lower-limb muscle activation	Longer leg length enhances vertical jump and agility

No	Indicator	Measurement Method / Tool	Rationale and Analytical Description	Expected Relationship to Volleyball Talent
		anthropometric tape	patterns critical for jumping mechanics.	components in volleyball.
5	Upper-Arm Circumference (cm)	Measured at the midpoint between the acromion and olecranon processes	Serves as an indicator of muscle mass and upper-body strength, influencing ball velocity during serves and spikes. A high circumference reflects developed musculature relevant to power output.	A greater circumference predicts more substantial spike-and-serve performance.
6	Hand Length (cm)	Distance from wrist crease to tip of middle finger	Hand size is associated with ball handling, grip stability, and control during setting or serving. Hand length contributes to the ball's surface area in contact, which is essential for technical execution.	Larger hand length facilitates ball control and technical accuracy.
7	Calf Circumference (cm)	Measured at the widest part of the calf using flexible tape	Reflects lower-limb muscular development and power, particularly for jumping and stability. Calf muscle girth is strongly correlated with explosive vertical performance in youth athletes.	A greater circumference indicates better jumping and landing stability.

The analytical results of the Early Volleyball Anthropometric Talent Test (EVATT-6/9) confirmed that the instrument is both valid and reliable for identifying early indicators of volleyball talent in children aged 6–9 years. The seven anthropometric indicators—body height, arm span, standing reach, leg length, upper-arm circumference, hand length, and calf circumference collectively describe two main dimensions: upper-body reach and control, and lower-body power and support. Together, these dimensions explain more than 70% of the total variance, indicating strong internal coherence among the measured variables. Statistical tests also showed high reliability, with Cronbach's $\alpha = 0.87$ and ICC = 0.89, indicating consistent results over time.

Furthermore, the composite score, the Anthropometric Talent Potential Index (ATPI), was positively correlated with children's motor coordination ($r = 0.68$, $p < 0.01$), suggesting that favorable anthropometric characteristics are associated with better movement ability—an essential foundation for volleyball skill development. These findings demonstrate that EVATT-6/9 effectively integrates relevant physical dimensions that contribute to early volleyball performance potential. The instrument's strength lies in its simplicity, practicality, and scientific grounding, making it suitable for coaches, teachers, and sport academies to identify and nurture young volleyball talent in school and community settings.

Data analysis was conducted systematically to examine the validity and reliability of the Early Volleyball Anthropometric Talent Test (EVATT-6/9). All analyses were carried out using SPSS version 27 and AMOS version 26. First, descriptive statistics (mean, standard deviation, minimum, maximum, and percentiles) were calculated to describe the anthropometric characteristics of the 90 participants by age and gender. These results provided an overview of the data distribution and served as the basis for developing normative reference values for early talent identification. To verify that the instrument measured the intended constructs, several types of validity testing were conducted. Content validity was assessed by expert evaluation using Aiken's V coefficient, where all indicators scored above 0.80, indicating strong expert agreement. Construct validity was examined using a two-step factor analysis. The Exploratory Factor Analysis (EFA) identified two main factors—upper-body reach and control, and lower-body power and support—which together accounted for more than 70% of the total variance. This structure was then confirmed through Confirmatory Factor Analysis (CFA), which showed good model fit (CFI = 0.94, TLI = 0.91, RMSEA = 0.061), confirming that the EVATT-6/9 had a consistent and valid measurement model.

Reliability analysis was carried out using two approaches. Internal consistency reached Cronbach's $\alpha = 0.87$, indicating strong coherence among indicators, while test–retest reliability showed an Intraclass Correlation Coefficient (ICC) = 0.89, confirming measurement stability across two sessions separated by two weeks. Criterion-related validity was also tested by correlating the composite Anthropometric Talent Potential Index (ATPI) with motor coordination scores from a standardized physical fitness test. A significant positive correlation ($r = 0.68$, $p < 0.01$) indicated that children with better anthropometric profiles also showed higher coordination levels. Additionally, independent-samples *t*-tests were used to examine gender differences, and percentile ranks were established to provide reference categories for talent evaluation.

RESULT AND DISCUSSION

The analysis of data collected from 90 elementary school students in Pekanbaru (aged 6–9 years) aimed to evaluate the psychometric properties and practical applicability of the Early Volleyball Anthropometric Talent Test (EVATT-6/9). The results are presented in four stages corresponding to the research procedures: (1) Descriptive statistics of anthropometric indicators, (2) Content validity analysis through expert evaluation, (3) Construct validity and factorial structure using exploratory and confirmatory factor analyses, and (4) Reliability testing and criterion-related validation. Each stage contributes evidence supporting the validity,

reliability, and interpretive strength of the EVATT-6/9 as a scientifically grounded tool for early talent identification in volleyball.

The descriptive results provide an overview of participants' physical characteristics by age and gender. These findings serve as the empirical foundation for the creation of normative reference values and percentile classifications.

Table 2. Descriptive Statistics of Anthropometric Indicators (N = 90)

Indicator	Mean (M)	SD	Min	Max	Male (M ± SD)	Female (M ± SD)
Body Height (cm)	124.83	7.42	110.2	139.5	126.55 ± 6.98	123.11 ± 7.60
Arm Span (cm)	127.42	7.60	112.8	141.3	128.97 ± 7.15	125.87 ± 7.83
Standing Reach (cm)	162.44	8.21	145.4	179.2	164.10 ± 8.05	160.78 ± 8.37
Leg Length (cm)	64.38	4.12	56.5	72.3	65.02 ± 4.06	63.74 ± 4.20
Upper Arm Circumference (cm)	17.91	1.74	14.8	21.3	18.20 ± 1.71	17.62 ± 1.76
Hand Length (cm)	13.78	0.84	12.2	15.6	13.95 ± 0.81	13.61 ± 0.86
Calf Circumference (cm)	23.46	1.95	19.4	26.9	23.81 ± 1.88	23.11 ± 2.01

Overall, male participants scored slightly higher on all anthropometric indicators than female participants, reflecting normal gender-related growth trends during early childhood. The observed variability (SD range = 0.8–8.2 cm) indicates adequate dispersion, supporting the instrument's ability to differentiate among individual characteristics within the same age range. Seven experts evaluated each anthropometric indicator for relevance, clarity, and feasibility in measuring volleyball-related potential among children aged 6–9. The Aiken's V index was computed for each indicator.

Table 3. Expert Validation and Aiken's V Coefficient

Indicator	Mean Expert Rating	Aiken's V	Decision
Body Height	3.91	0.98	Retained
Arm Span	3.86	0.96	Retained
Standing Reach	3.89	0.97	Retained
Leg Length	3.74	0.94	Retained
Upper Arm Circumference	3.83	0.95	Retained
Hand Length	3.77	0.94	Retained
Calf Circumference	3.80	0.95	Retained

All indicators met Aiken's V ≥ 0.94 criterion, indicating strong expert agreement and excellent content validity. The high consensus supports that all selected anthropometric variables are relevant, age-appropriate, and feasible for early volleyball talent assessment. Exploratory Factor Analysis (EFA) using Principal Axis Factoring with Varimax rotation identified two latent dimensions. The Kaiser–Meyer–Olkin (KMO) value of 0.812 and Bartlett's

Test of Sphericity ($\chi^2 = 264.21$, $p < 0.001$) indicated sampling adequacy and factorability of the correlation matrix.

Table 4. Exploratory Factor Analysis Results

Indicator	Factor 1: Upper-Body Reach & Control	Factor 2: Lower-Body Power & Support
Body Height	0.88	—
Arm Span	0.84	—
Standing Reach	0.81	—
Hand Length	0.72	—
Leg Length	—	0.76
Upper Arm Circumference	—	0.74
Calf Circumference	—	0.71
Eigenvalue	3.91	1.15
% Variance Explained	55.8%	16.6%
Cumulative Variance	72.4%	—

The EFA confirmed a two-factor structure, explaining 72.4% of the total variance, supporting the theoretical framework that early childhood volleyball talent potential can be represented by upper-body reach/control and lower-body strength/power dimensions. Confirmatory Factor Analysis (CFA) was conducted to validate this structure. Fit indices demonstrated an excellent model fit: $\chi^2/df = 1.98$, CFI = 0.94, TLI = 0.91, RMSEA = 0.061. This confirms that the EVATT-6/9 measurement model reflects a coherent, valid, and theoretically consistent factorial structure for anthropometric profiling of volleyball talent. Reliability was assessed through internal consistency (Cronbach's α) and test–retest reliability (Intraclass Correlation Coefficient, ICC).

Table 5. Reliability Analysis Results

Indicator	Cronbach's α (Internal Consistency)	ICC (Test–Retest Reliability)	Decision
Body Height	0.85	0.90	Reliable
Arm Span	0.84	0.88	Reliable
Standing Reach	0.86	0.91	Reliable
Leg Length	0.82	0.87	Reliable
Upper Arm Circumference	0.79	0.86	Reliable
Hand Length	0.81	0.88	Reliable
Calf Circumference	0.83	0.89	Reliable
Composite (EVATT-6/9)	0.87	0.89	Highly Reliable

All items exhibited $\alpha > 0.79$ and ICC > 0.85, surpassing the acceptable thresholds (≥ 0.70). These results confirm strong internal coherence and excellent temporal stability of the EVATT-6/9, meaning the instrument provides consistent measurements across repeated sessions. Criterion validity was established by correlating the Anthropometric Talent Potential Index (ATPI)—the composite score from EVATT-6/9—with a standardized motor coordination test score.

Table 6. Correlation between ATPI and Motor Coordination Score

Variable	r-value	p-value	Interpretation
ATPI vs. Motor Coordination	0.68	< 0.01	Moderate-to-Strong Positive Correlation

The significant correlation ($r = 0.68$, $p < 0.01$) indicates that children with superior anthropometric profiles tend to demonstrate higher motor coordination. This supports the theoretical link between body structure and functional movement performance, confirming that anthropometric potential is a meaningful predictor of early volleyball readiness. To support practical applications in schools and sports academies, percentile ranks were established for each indicator, enabling practitioners to classify children's potential (e.g., below average, average, above average).

Table 7. Example of Normative Percentile Ranges (Ages 6–9 Years)

Indicator	Below Average (< 25th %)	Average (25–75th %)	Above Average (> 75th %)
Body Height (cm)	< 119.0	119.0 – 129.0	> 129.0
Arm Span (cm)	< 121.5	121.5 – 132.5	> 132.5
Standing Reach (cm)	< 154.0	154.0 – 168.0	> 168.0
Leg Length (cm)	< 60.0	60.0 – 68.0	> 68.0
Upper Arm Circumference (cm)	< 16.5	16.5 – 19.5	> 19.5
Hand Length (cm)	< 13.0	13.0 – 14.5	> 14.5
Calf Circumference (cm)	< 21.5	21.5 – 25.0	> 25.0

These percentile classifications enable teachers and coaches to easily interpret individual results relative to peers. For example, a child with an arm span of> 132.5 cm (above the 75th percentile) may have above-average reach potential relevant to volleyball performance. The cumulative results demonstrate that the EVATT-6/9 meets all psychometric standards for a valid and reliable instrument. It proves strong content validity (Aiken's $V > 0.90$), robust construct validity (two-factor model, CFI = 0.94), excellent reliability ($\alpha = 0.87$, ICC = 0.89), and meaningful criterion-related validity ($r = 0.68$, $p < 0.01$). The instrument successfully differentiates children's anthropometric potential and provides normative benchmarks for early talent identification. Therefore, EVATT-6/9 can be confidently recommended as a scientifically grounded, field-ready diagnostic tool for identifying young volleyball talents aged 6–9 years,

facilitating early, evidence-based athlete development pathways in educational and sports contexts.

DISCUSSION

The two-factor structure identified through factor analysis—upper-body reach and control, and lower-body power and support—aligns with previous findings emphasizing the central role of anthropometric and physical attributes in volleyball performance. (Rosalina et al., 2024). Height, arm span, and standing reach emerged as dominant contributors to upper-body reach, supporting evidence from Rubajczyk & Rokita, (2020) Taller, longer-limbed athletes demonstrate superior spiking and blocking capabilities. Similarly, leg length and calf circumference correlated with lower-body power, confirming that lower-limb leverage and muscularity significantly affect vertical jump performance and agility—two critical components of volleyball. (Syahputra et al., 2025).

The significant positive correlation between the Anthropometric Talent Potential Index (ATPI) and motor coordination ($r = 0.68$, $p < 0.01$) is consistent with the notion that morphological potential and movement proficiency are interrelated during early childhood. (Hardiansyah & AR, 2022). Children with favorable anthropometric traits often exhibit higher body control and balance, facilitating the acquisition of sport-specific motor skills. This finding corroborates Ochs et al. (2025), who emphasized that early talent detection requires integrated evaluation of body dimensions and coordination, as both domains underpin long-term skill progression in sport.

The observed gender differences, with boys slightly outperforming girls in most anthropometric indicators, mirror natural physiological patterns found in prior youth studies. (de Oliveira & al., 2024). Such differences, however, remained within normal developmental ranges, indicating that the EVATT-6/9 can be applied equitably to both sexes with age- and gender-specific percentile adjustments. Notably, the factorial stability of the instrument across the full age range (6–9 years) demonstrates that anthropometric structures become measurable and reliable even before puberty, supporting early detection as proposed by Panggraita et al., (2023) In their longitudinal research on early sport specialization.

Furthermore, the psychometric robustness of the EVATT-6/9 surpasses that of generic fitness tests (e.g., Eurofit, TGMD-2), which tend to focus on general coordination rather than sport-specific morphological suitability. The current findings, therefore, fill a significant methodological gap in early talent identification, as noted by Rosalina et al., (2024), who highlighted the lack of validated, sport-specific talent-detection tools for pre-adolescent athletes.

From a theoretical standpoint, the findings reinforce the multidimensional nature of talent identification, integrating anthropometric, physical, and coordinative dimensions. The two-factor structure identified in this study confirms that early volleyball talent can be conceptualized through a balance of reach-related morphology and power-related development. This aligns with the Long-Term Athlete Development (LTAD) framework, which posits that early detection of innate physical characteristics can guide individualized training and maximize long-term performance outcomes. (William & Mekoulou, 2024). The EVATT-6/9 contributes to talent identification theory by operationalizing potential in measurable, standardized parameters, moving beyond subjective assessments traditionally used in youth sport scouting. The factorial validation supports the argument that early anthropometric configurations are stable enough to inform structured development pathways. This provides a quantitative foundation for bridging the gap between natural growth tendencies and sport-specific performance modeling.

Despite its strong methodological framework, several limitations should be acknowledged. First, the study involved a relatively small and region-specific sample (N = 90) drawn from three schools in Pekanbaru, which may limit the generalizability of the findings to broader populations. Future research should involve larger, more geographically diverse samples to enhance external validity. Second, the study focused solely on anthropometric indicators, omitting physiological and psychological variables such as reaction time, motivation, and sport interest, which also contribute to holistic talent profiling. Integrating these dimensions would yield a more comprehensive model of early volleyball potential. Third, the cross-sectional design restricts causal inference; longitudinal studies are needed to examine whether early anthropometric advantages predict actual performance outcomes during adolescence. Finally, environmental factors such as nutrition, growth tempo, and school activity levels were not controlled, which might have influenced measurement outcomes.

Future studies should extend this work by (a) applying the EVATT-6/9 across multiple regions and ethnic groups to establish national normative data; (b) integrating motor performance, physiological capacity, and psychological motivation into a unified predictive model; (c) conducting longitudinal tracking from childhood to adolescence to validate the predictive power of early anthropometric indicators; and (d) adapting the test for digital or mobile-based applications to facilitate broader implementation in schools. Additionally, comparative research between volleyball and other team sports (e.g., basketball, badminton) would help determine whether specific anthropometric traits are sport-specific or transferable. By expanding the EVATT-6/9 framework in these directions, future research could advance

the field of evidence-based talent identification and enhance the scientific basis of early athlete development.

CONCLUSION

This study successfully developed and validated the Early Volleyball Anthropometric Talent Test (EVATT-6/9) as a reliable and valid instrument for identifying early indicators of volleyball talent among children aged 6–9 years. The results demonstrated strong content validity (Aiken's $V > 0.90$), a clear two-factor structure representing upper-body reach and control and lower-body power and support, and excellent reliability (Cronbach's $\alpha = 0.87$; ICC = 0.89). Furthermore, the Anthropometric Talent Potential Index (ATPI) showed a significant positive correlation with motor coordination ($r = 0.68$, $p < 0.01$), confirming the test's practical relevance for early talent identification. The EVATT-6/9 offers a scientifically grounded and field-ready approach for use in schools, sports academies, and early athlete development programs. Its simplicity and non-invasive nature make it applicable in resource-limited settings while maintaining measurement precision. The instrument provides a structured method for detecting promising young athletes and supporting evidence-based decisions in early sport development initiatives.

However, this study was limited to a relatively small sample drawn from three schools in Pekanbaru. Future research should expand testing across regions and cultures to establish broader normative data. Longitudinal studies are also recommended to evaluate the predictive validity of early anthropometric profiles for later volleyball performance. Additionally, integrating physiological, psychological, and motor-skill components into future models would create a more holistic framework for early talent identification.

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