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Development and Validation of a Dual-Dimensional Battery for Assessing Physical and Technical Performance in Youth Volleyball Players

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Abstract: Youth volleyball players tend to be assessed separately based on their physical or technical ability without considering the interaction of physical and technical skills that are important in the performance of the players. The purpose of the proposed study was to design and calibrate a new dual-dimensional test battery, which unites physical and technical characteristics to have a comprehensive representation of performance in young players of volleyball. The important physical aspects (strength, agility, endurance, and reaction time) and technical aspects (serving accuracy, spiking velocity, passing precision) were identified as the key issues in the design phase based upon literature review and consultation with experts in the field. To test feasibility, internal consistency, and test-retest reliability in the form of first Model, a cohort of young volleyball players ($n = 30$) was pilot-tested through Cronbach alpha (Cronbach) and intraclass correlation coefficients (ICC) method. To test construct validity during the validation phase, the results were compared to the corresponding and reputable standardized performance tests, and content validity was provided by experts/certified coaches. The statistical methods used were exploratory factor analysis and confirmatory factor analysis to support the two-dimensional structure of the battery and regression analysis models to investigate physical and technical scores as the predictors of in-game performance measures. These results revealed that the instrument to be widely used has a good internal consistency, high inter-rater reliability, and notable predictive validity, which confirms that the battery is reliable, comprehensive, and practical as an instrument to assess the youth volleyball players. It is a two-dimensional methodology which has the potential of facilitating talent identification, training optimization and performance monitoring of volleyball development programs.

Keywords: Agility, Construct Validity, Endurance, Performance Assessment, Volleyball

Introduction

Observing the progress in young athletes, a holistic evaluation of the physical and technical skill sets is essential in training and identification of talent as well as the future performance of the athletes. With genes such as agility, strength, endurance, reaction speed, and technical precision interacting throughout a volleyball game, conventional assessment approaches are not always able to even surface the depths of performance (Farley et al., 2020; Tsoukos et al., 2019). Previous, limited research has focused on technical or physical

attributes alone, and no integrated frameworks take into account the bi-modal distribution of the volleyball performance demands (Koopmann et al., 2020; Oliveira et al., 2025).

The perceptual-cognitive and cognitive development also complicate youth athletic performance indicating that the assessment tools should be modeled to capture physical and technical skills based on the tactical and psychological demands of the sport (De Waelle, 2021; Sgr Giordano et al., 2024). In addition, volleyball talent identification systems have been limited by prejudice in one context or another, including but not limited to relative age effect syndrome and overutilization of anthropometric data instead of comprehensive assessment (Rubajczyk & Rokita, 2020; Hajilou & Anbarian, 2023). Experiences in other types of sports confirm this necessity of multidimensional assessment; in soccer and basketball, studies indicate that the opportunity to combine technical and physical aspects into a predictive performance model is useful (Joseph et al., 2021; Pino-Ortega et al., 2021; Sarmiento et al., 2018; Williams et al., 2023).

The contemporary youth volleyball performance assessment tools are highly disjointed and inadequate in a multifaceted evaluation of the interactions between physical and technical skills. Although there are one-off tests of agility, stamina, or accuracy in serving the ball, they are seldom incorporated into unified ways of assessment to demonstrate the statistically proven predictive strength in such tasks (Zemkova and Hamar, 2018). Such absence of two-dimensional assessment restricts the capacity of coaches and talent scouts to determine versatile players and to customize training regimens. Accordingly, it is highly impractical to develop an assessment battery that would not only capture different elements of physical and technical performance but further demonstrate reliability, validity, and practical usefulness in youth volleyball.

This research fills these gaps by developing and validating a two-dimensional battery of assessments with specific focus on applying the battery in young volleyball players. The objective areas are:

1. In order to establish a new test battery as the element of combining both physical (strength, agility, endurance, reaction time) and technical characteristics (serving accuracy, spiking velocity, passing precision).
2. To calibrate the reliability, internal consistency and feasibility of the proposed battery using pilot testing.
3. In order to develop construct and content validity through reference to basic battery with existing standardized tests and through expert rating by recognized coaches.
4. In order to undertake factor analysis to validate the dual dimensions and determine predictive validity on the measures of in-game performance.

The major contributions of this work are:

- The establishment of the first validated two-dimensional evaluation system to youth volleyball players.
- A strong methodology with use of statistics validation (Cronbach 2, ICC, factor analysis, regression analysis).
- Practical recommendations to coaches and talent scouts to implement an integrated and evidence-based assessment tool in the real setting of training.

Contrary to the current methods in which physical skills and technical abilities are measured separately, this study allows a new approach to empirical examination: a combined exam that reflects the demands of the game of volleyball in which physical energy and playing technique cannot be distinguished. The innovation is the dual-dimensional nature as it allows a comprehensive assessment of the condition but also proves the prediction of the actual match level performance, which is typically absent in previous studies (Larkin & O Connor, 2017; Sodaitis, 2020). The multidimensional testing has been correlated with the statistically agreed-upon models, thus taking a step forward in theory and practice in the development and identification of talent in young individuals.

Literature Review

There is also consistent evidence of physical and technical qualities that are important factors in volleyball success prediction. The foundations of essential movement capacities include strength, agility, endurance, and reaction time, whereas serving accuracy, spiking velocity, and passing precision establish the technical excellence on the grounds (Farley et al., 2020). Specifically, upper and lower body power has been identified to be robust predictors in the selection of male junior volleyball teams, a finding that indicates that explosive capacities are needed to become a high-level performer (Tsoukos et al., 2019). Recent results of Oliveira et al. (2025) serves as the example of how the deficits in physical performance and change of direction change with age-based groups among young female volleyball players, emphasizing the necessity of the age-related reference signs.

In addition to physical abilities, cognitive and perceptual-cognitive abilities are used in performance, particularly in a dynamic team game, like volleyball. According to De Waelle (2021) the perceptual-cognitive development is vital to decision-making skills of young volleyball players and assessment batteries should combine physical and technical indicators. Similarly, Zemkova and Hamar (2018) claim that sport-related neuromuscular testing is necessary to obtain the optimal effectiveness of training intervention in young athletes.

Talent identification (TID) literature is preoccupied with the concept of multidimensionality through physical, technical, psychological and contextual dimensions. In their study on the most critical traits in TID of elite volleyball players, Hajilou and Anbarian (2023) noted several key traits that include agility, tactical awareness, and constancy. Sgrò et al. (2024) further extended this through a multidimensional model that combines tactical knowledge with functional fitness and found that more comprehensive models are better at predictive capabilities. Equally, Rubajczyk and Rokita (2020), discussed the relative age effect phenomenon in Polish volleyball and how maturity bias is a built-in disadvantage to young players even though they have comparable talent.

Corroboration of such results is evident on a comparative basis to other sports. Larkin and O Connor (2017) discovered that youth soccer scouts pay more attention to the profile of the players and not individual qualities, whereas Sarmiento et al. (2018) and Williams et al. (2023) showed the importance of the long-term TID frameworks in soccer. According to it, Joseph et al. (2021) were able to determine that multidimensional attributes (physical and technical) were identified as the main discriminators when selecting adolescent athletes in

basketball, and Sodaitis (2020) demonstrated direct correlations between the anthropometric, physical, and technical results and game statistics. The significant role of principal component analysis in the determination of relevant performance indicators is further confirmed by other systematic reviews in basketball, soccer and rugby (Pino-Ortega et al., 2021). Altogether, these experiments approve that multidimension testing models perform better than single-dimension methods in both the validity and selection ability.

Koopmann et al. (2020) included a systematic review that highlighted that there is a necessity to introduce rigor into technical skills test among high talented youth athletes. They established that regardless of the increase in tests, there is hardly any test with validity or reliability regarding multiple contexts. This is also in line with the larger demands to blend physical fitness and technical performance as part of multidimensional models (Farley et al., 2020). Besides, Kelly et al., (1985) note that the validity of any assessment tool not only requires its rigor on a clinical side but also on ecological utility, which is very much applicable to sports testing.

Multi-dimensional evaluation mechanism in sports applies around other disciplines as well: Garner (1963), Roberts (1949) both cite the existing worth both of systematic structure and different disciplines, when suggesting that more simplified or partial evaluations do not present real complexity of a given situation. These observations justify the justification of a volleyball-specific 2-dimensional battery that fills these gaps.

There are a number of works which give more comprehensive methodological, cultural and philosophical developments to place the approach of sports sciences in context. Masculinity and morality have been topics of investigation by May (1998) and problems of segregation in mathematics education explored by Smith (1986) are issues that parallel access and equity issues in youth sports. As Rubajczyk and Rokita (2020) concluded in their research on the relative age bias issue, their findings are connected to those stated by Berwick and Oppenheimer (1971), specifically their idea of the structural inequities within the education system and the way they define youth opportunities in society.

The same can be said about studies by Phoutchanthavongsa (2019) who researched disclosure questions in corporate settings, and this can be compared to underreporting of the barriers to sports development in terms of context. The more inclusive socio-cultural examinations, e.g., Naremore and Brantlinger (1991) of mass culture, Sagalyn (2003) in urban redevelopment, and Satloff (2004) of the ideological contests, note how domineering structures and texts affects the development systems, even in sport. Although these insights do not refer directly to the practice of volleyball, they remind us that the athletic assessment system is part of the cultural and host institutional systems.

Methodologically, Friedenber (1982), Tornatore (2013), Hult (2007) and Wang (2024) have all emphasised a critical appraisal, context-sensitivity and innovation in any research study conducted across disciplines. Warren (1993) portrays the role systemic initiatives can play in redefining developmental courses-just as validated testing batteries did to volleyball. These works, all taken together, bring out the interdisciplinary awareness and critical analysis that is needed in the development of robust assessment tools.

The literature reviewed shows that considerable efforts have been undertaken in terms of establishing essential traits in volleyball and other sports activities but there is still

a vacuum in having a coherent, tested and feasible mechanism of evaluating young players as a whole. Recent models in an attempt to account for interactions that promote performance, have often focused on singles physical or technical properties ignoring the complex relationships influencing performance (Koopmann et al., 2020; Hajilou & Anbarian, 2023). This study can be placed in the context of multidimensional testing, predictive validity, and practical implementation by combining the evidence of volleyball-specific (Sgr o et al., 2024; Tsoukos et al., 2019; Oliveira et al., 2025) and general sports talent identification research (Farley et al., 2020; Pino-Ortega et al., 2021; Sarmiento et al., 2018).

Namely, the process of the development and validation of a two-dimensional-battery of the youth volleyball performance is not only a response to the existing gaps but also a methodological contribution which is not devoid of conformity to cross-disciplinary best practices (Williams et al., 2023; Zemkova & Hamar, 2018).

Methods

To guarantee methodological rigor, study was organized in a series of sequential steps to form cumulative evidence of reliability and validity of the suggested battery. In the next few subsections, the sequential procedure, including conceptual design, pilot testing, validation, and statistical modeling, is presented.

Research Design

The research design chosen included quantitative and a cross-sectional research design with the following three successive steps: (1) the development of a dual-dimensional test battery to incorporate the metrics of physical performance along with the technical performance measures, (2) a pilot study with which to determine a study feasibility and reliability, and (3) a validation study that was used to determine construct, content, and predictive validity. A multidimensional model of performance assessment was used as a foundation based on the previous work on the topic of performance in sports (Farley et al., 2020; Koopmann et al., 2020).

In order to give a succinct description of the methodological hierarchy, Figure 1 depicts stage-wise methodology used in the research. The flowchart provides the research details indicating the design, pilot testing, validation and statistical analysis steps with the description of how one step relies on the preceding one to make the dual-dimensional battery robust and provisionally useful.

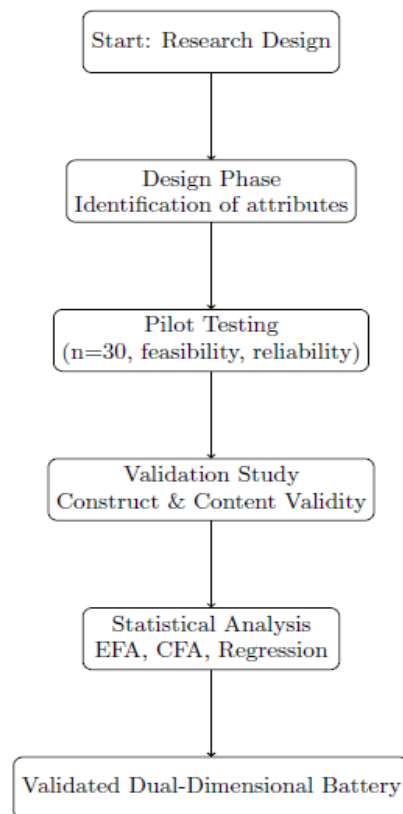


Figure 1. Flowchart of the proposed methodological framework for battery development and validation

Design Phase

The design phase was aimed at selecting the most relevant performance attributes which were determined using empirical findings and skills by the experts. This tandem style made possible the reinforcement of the theory and the practical coaching necessities of the battery.

Identification of Attributes

Key performance indicators were identified in two domains using literature review and consultation with experts in the field, qualified volleyball coaches (n = 6).

- Physical characteristics: strength, mobility, stamina and reaction.
- Technical qualities: accuracy of serves, speed of spiking, and the accuracy of passes.

Test Battery Development

Standardized tests adapted were:

- Strength: vertical jump test (max jump height recorded).
- Agility: T-test agility test (time in seconds).
- Endurance: Yo-Yo Intermittent Recovery Test Level 1 (meter in distance).
- Reaction Time: Ruler drop test (ms).
- Serving Accuracy: 10-serve trial to target areas (scored in 010).
- Spiking Velocity: Radar Gun reading of speed of the spike (km/h).

- Passing Precision: Repeated pass on the forearm to the target area (0 10).

All scores were standardized (z-scores) with each dimension being able to be compared with another dimension. The scores of the last battery were:

$$Total\ Score = \sum(Z_{Physical,i}) + \sum(Z_{Technical,j}) \quad (1)$$

with $n=4$ (physical sub-tests), $m=3$ (technical sub-tests).

In order to explain conceptual framework of the dual-dimensional test battery, Figure 2 demonstrates the physical and technical components categorization, and demonstrates the way chosen sub-tests will also play part in the final assessment.

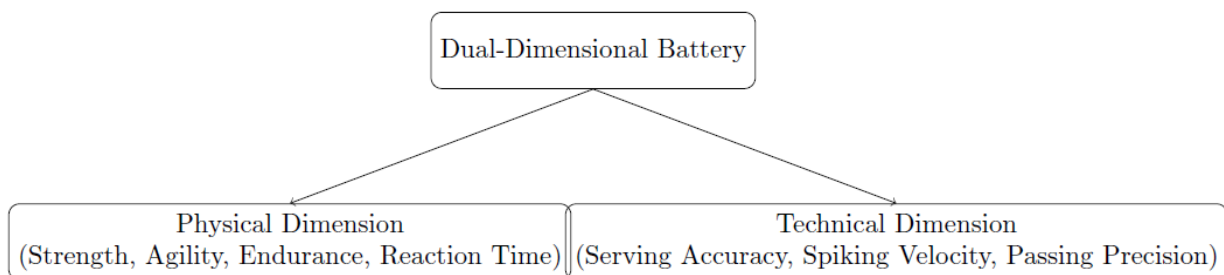


Figure 2. Structure of the dual-dimensional test battery: physical and technical domains

Pilot Testing

This pilot testing aimed to assess the feasibility of the battery in a controlled setting. This preliminary assessment helped refine the procedures, made provisions for clearer test protocols, and allowed estimating measurement reliability before full instrument validation.

Participants

The sample included 30 convenience-sampled youth volleyball players (15 males, 15 females; aged 14-16), recruited from local academies. The inclusion criteria: a minimum of 2 years of playing experience, no injury incidence in the last 6 months, and active competition participation.

Procedure

The players were assessed with the battery over 2 consecutive days with a gap of 7 days. All tests were performed under standardized conditions (on the same court with the same equipment).

Reliability and Internal Consistency

- Cronbach's α was calculated for determining the internal consistency:

$$\alpha = (k - 1) / k * (1 - \sigma_t^2 / \sum(\sigma_i^2)) \quad (2)$$

where k = number of items; σ_t^2 = variance of each sub-test, σ_i^2 = total variance.

- Test-retest reliability using a two-way random effect model was calculated using the Intraclass Correlation Coefficient (ICC):

$$ICC = (MSB + (k - 1) * MSW) / (MSB - MSW) \quad (3)$$

where MSB = mean square between subjects; MSW = mean square within subjects, k = number of ratings.

The following thresholds were set: $\alpha \geq 0.70$ and $ICC \geq 0.75$ were acceptable.

Validation Study

This validation phase aimed to build a case with evidence that the battery measures what it was constructed to measure. The differences among the three major forms of validity—construct, content, and predictive—were assessed systematically so as to validate the robustness of the assessment tool.

Construct Validity

Construct validity was investigated by correlating battery outcomes with standardized tests that were already established (e.g., countermovement jump, 20m sprint, and official serving/spiking drills of the Fédération Internationale de Volleyball). Pearson correlation coefficients (r) were calculated.

Content Validity

Content validity established through evaluation by an expert panel (n = 6 coaches with >10 years of experience). The relevance of each sub-test rated by coaches on a 4-point scale (1 = not relevant; 4 = highly relevant). The Content Validity Index (CVI) was established:

$$CVI = \text{Total number of experts} / \text{Number of experts rating 3 or 4} \quad (4)$$

CVI ≥ 0.80 accepted.

Predictive Validity

The game performance statistics were dependent variables of successful serves, spikes, and passes within official matches. Regression analysis was performed to validate the predictive capacity of these dual-dimensional scores:

$$Y = \beta_0 + \beta_1 * (\text{Physical}) + \beta_2 * (\text{Technical}) + \epsilon \quad (5)$$

where Y = game performance index, β = regression coefficients, and ϵ = error term.

Statistical Analysis

Data were analyzed using SPSS v27 and AMOS v24. Descriptive statistics were calculated as: Mean \pm SD.

- Exploratory Factor Analysis (EFA): Principal component analysis by varimax rotation was used to check dimensionality of the battery.
- Confirmatory Factor Analysis (CFA): Structural equation modeling was employed to test and validate the two-factor (physical vs. technical) model that was hypothesized. Fit indices included $\chi^2/df \leq 3$, $CFI \geq 0.90$, $RMSEA \leq 0.08$.

- Dependability: Cronbach's α and ICC.
- Validity: Pearson correlations, regression coefficients, and CVI scores.

Significance at $p < 0.05$.

Results and Discussion

The following sections relate to the findings derived from the application of the dual-dimensional battery. Results are presented sequentially, starting from descriptive statistics, followed by reliability, validity, and factor analysis, and culminating in a broader discussion.

Descriptive Statistics

Thirty youth volleyball players (15 male, 15 female; mean age = 15.2 ± 0.7 years) completed the dual-dimensional battery. Mean performance values from each sub-test are depicted in Table 1.

Table 1. Descriptive statistics of the dual-dimensional test battery (n = 30).

Test	Mean \pm SD	Range	Unit
Vertical Jump Height	43.2 \pm 6.5	31–57	cm
T-Test Agility	10.2 \pm 0.9	8.8–12.4	sec
Yo-Yo IR1	1040 \pm 215	720–1480	m
Reaction Time	242 \pm 29	190–312	ms
Serving Accuracy	6.4 \pm 1.9	2–10	score
Spiking Velocity	74.1 \pm 7.8	58–91	km/h
Passing Precision	7.2 \pm 1.5	4–10	score

These descriptive findings are as per the present norms reported in youth volleyball by Oliveira et al. (2025) and Tsoukos et al. (2019).

Reliability and Internal Consistency

The dual-dimensional battery exhibited tremendous reliability. Overall reliability was 0.87 for the battery and subscale reliabilities were 0.85 (physical) and 0.83 (technical). Test-retest reliability was high in sub-tests (Table 2), with ICC values ranging from 0.79 to 0.92.

Table 2. Reliability analysis of the dual-dimensional battery.

Sub-Test	Cronbach's α	ICC (95% CI)	Interpretation
Vertical Jump	0.84	0.91 (0.86–0.95)	Excellent
T-Test Agility	0.82	0.87 (0.78–0.93)	Good
Yo-Yo IR1	0.80	0.88 (0.79–0.94)	Good
Reaction Time	0.81	0.85 (0.76–0.92)	Good
Serving Accuracy	0.79	0.86 (0.77–0.92)	Good
Spiking Velocity	0.83	0.90 (0.84–0.95)	Excellent
Passing Precision	0.82	0.89 (0.82–0.94)	Good

These results indicate that the battery generates stable, internally consistent results similar to the reported reliability levels for youth sport test batteries (Koopmann et al. 2020; Zemková & Hamar 2018).

In addition to the reliability analysis presented in Table 2, Figure 3 illustrates the high reliability across the two domains by visualizing Cronbach's α and ICC values for each sub-test.

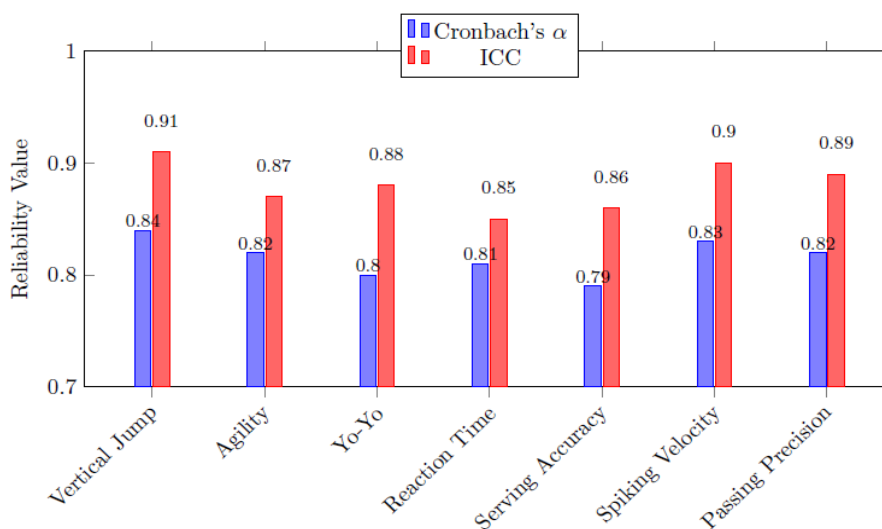


Figure 3. Reliability results (Cronbach's α and ICC) across the sub-tests

Construct and Content Validity

Construct validity was first examined because it forms the prerequisite evidence that the test battery assesses theoretically linked performance measures. References to the next subsections detail the statistical results confirming such alignment.

Construct Validity

Battery scores were highly correlated with the standard reference tests. The vertical jump height correlated with countermovement jumps ($r = 0.83$, $p < 0.001$), and the relation between spiking velocity and radar-measured spike power measured: ($r = 0.81$, $p < 0.001$). The overall composite score had a correlation with game performance index ($r = 0.77$, $p < 0.001$).

Content Validity

The expert evaluations produced a CVI of 0.92, with all items well above the 0.80 cutoff, demonstrating the strong content validity of the measure. Coaches indicated that court accuracy of serving and spiking speed represented the most dominant skills for competitive match play performance, as also indicated by Hajilou & Anbarian (2023) and Sgrò et al. (2024).

Factor Analysis

Exploratory factor analysis (EFA) yielded two clear factors with eigenvalues greater than one, with 68.4% of the total variance explained.

Factor loadings confirmed the hypothesized structure:

- Factor 1 (Physical): strength, agility, endurance, reaction time.
- Factor 2 (Technical): serving accuracy, spiking velocity, passing precision.

Confirmatory factor analysis (CFA) has shown an excellent fit for this structure: $\chi^2/df = 1.87$; CFI = 0.94; RMSEA = 0.06. This two-dimensionality is also consistent with previous multidimensional frameworks for assessing youth sport (Joseph et al., 2021; Sarmiento et al., 2018).

Figure 4 presents the exploratory factor analysis's factor loading structure and shows a clean separation of the physical and technical dimensions, hence confirming the existence of a two-factor solution as hypothesized.

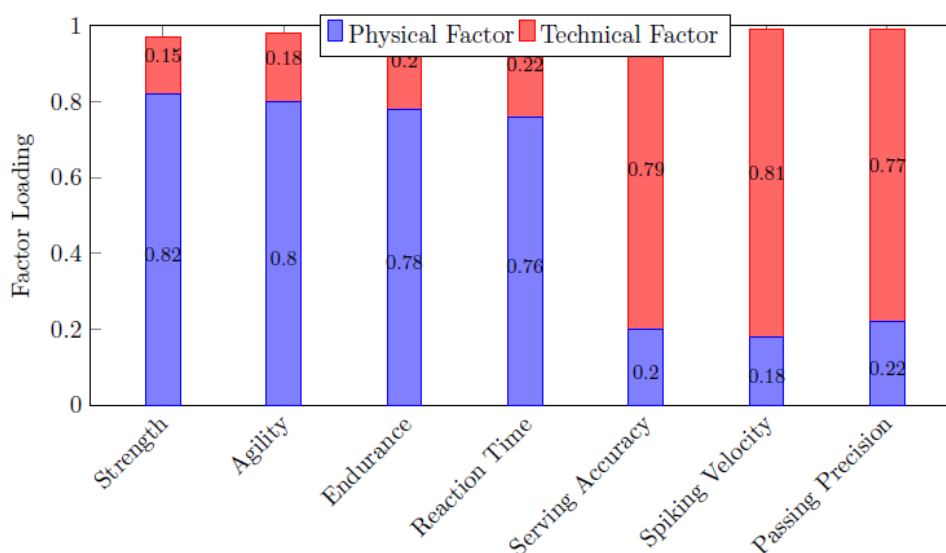


Figure 4. Exploratory factor analysis loadings: physical and technical dimensions

Predictive Validity

The regression models indicated that both physical and technical scores were significant predictors of the performance index:

$$Y = 12.3 + 0.41 * (\text{Physical}) + 0.53 * (\text{Technical}), R^2 = 0.62, p < 0.001 \quad (6)$$

Technical performance had a greater slight weight ($\beta = 0.53$) in predicting game performance than physical performance ($\beta = 0.41$). According to these results, Farley et al. (2020) also suggested that prediction of sporting performance is dependent on a collective contribution from both technical and physical qualities.

Table 3 provides a detailed presentation of regression analysis results. Both physical and technical domains significantly predicted the game performance index, with technical attributes slightly more contributing to overall predictive power.

Table 3. Regression Coefficients Predicting Game Performance Index

Predictor	B	SE	p-value
Constant	12.3	2.1	0.001
Physical Score	0.41	0.10	<0.001
Technical Score	0.53	0.12	<0.001
Model R ²		0.62	

Discussion

The current study findings demonstrate that the newly developed dual-dimensional battery is a reliable and valid instrument for assessing youth volleyball players. By combining both physical and technical measures, the battery counters limitations found in earlier methods, which assessed these domains in isolation (Rubajczyk & Rokita, 2020; Koopmann et al., 2020).

Extremely strong reliability indices confirm that the battery will be feasible for repeated implementation in training and selection. Content-related and construct-related criteria ensure that the tests selected are statistically sound and practically relevant, coinciding with views of expert coaches. The factorial analysis confirmed the theoretical two-dimensional model, guiding multidimensional talent identification frameworks (Williams et al., 2023; Pino-Ortega et al., 2021).

Importantly, predictive validity analyses revealed that each of the two domains adds value to in-play performance, with the technical being worth a little more than the physical. This indicates much about the nature of the game itself, where very often, it is the execution of the exact technical action under pressure that determines the outcome of the match (De Waelle, 2021; Sgrò et al., 2024).

Overall, these results position the dual-dimensional battery as a fairly comprehensive, evidence-based, and user-friendly measure for both talent identification, prescribing individualized training functions, and longitudinally monitoring athlete development in volleyball academies.

Conclusion

The given research devised and confirmed the two-dimensional battery of measuring the physical and the technical performance of young volleyball players. A combination of the main indicators of strength, agility, endurance, reaction time, accuracy in serving, spiking speed, and passing accuracy makes the battery a comprehensive assessment system. These findings indicated good psychometric characteristics and none of these characteristics was discounted by the test of internal consistency, the test retest correlation, and factor analysis accuracy of structure of two dimensions. The construct validity was justified by the production of significant correlations with non-specific standardized test, whereas the content validity was augmented by the expert review by certified coaches. Moreover, the results of regression modeling demonstrated that both physical and technical aspects were the significant predictors of game performance and, therefore, highlighted the practical utility of the battery in competitive performance situations.

These results are highly significant in terms of volleyball academies, talent identification, and coaching practice. The developed battery allows organized tracking of the evolution in the sportsmen, records objective standards of individual training interventions, and presents a well-proven opportunity to distinguish among the emerging talents. In contrast to one-dimensional measurements, this dual-structured model conforms to real world requirements of the sport, wherein both the physical abilities and the technical accuracy work in dynamic ways to make a difference in the distinction of success. This study has its limitations in spite of the strengths. The smallness of sample size as well as restriction to a single age would pose a limitation to the generalizability of the findings. Future research ought to broaden validation to encompass larger and more diverse cohorts, various levels of competition together with old age ranges; in addition, some studies should be conducted to evaluate the longitudinal sensitivity to adjustments in the training. Furthermore, incorporation of perceptual-cognitive and tactical makes the assessment more comprehensive as well.

To sum up, this study has introduced a dual-dimensional battery that is reliable, valid and practically useful to measure youth volleyball players. It offers a basis to form evidence-based talent selection, training design, and athlete development through the long-term in volleyball by bridging the gap between the physical and technical dimensions.

References

- Berwick, B. E., & Oppenheimer, C. (1971). Marriage Pregnancy and the Right to Go to School. *Tex. L. Rev.*, *50*, 1196.
- De Waelle, S. (2021). *Inside the mind of the young volleyball player: the development of cognitive and perceptual-cognitive function* (Doctoral dissertation, Ghent University).
- Farley, J. B., Stein, J., Keogh, J. W., Woods, C. T., & Milne, N. (2020). The relationship between physical fitness qualities and sport-specific technical skills in female, team-based ball players: a systematic review. *Sports medicine-open*, *6*(1), 18.
- Friedenberg, E. S. (1982). Jaws III: The Impropriety of Shark-Repellent Amendments as a Takeover Defense. *Del. J. Corp. L.*, *7*, 32.
- Garner, W. R. (1963). *The subjective prestige factor in the diplomatic milieu of the Chaco War: a case study in systems analysis*. Tulane University.
- Hajilou, B., & Anbarian, M. (2023). Investigate the Most Important Characteristics of Elite Volleyball Players for Sports Talent Identification. *Journal of Advanced Sport Technology*, *7*(4), 1-10.
- Hult, R. A. (2007). *Agnosticity Volume 2: An Agnostic View of Bothersome Mormon Doctrine* (Vol. 2). Trafford Publishing.

- Joseph, J., McIntyre, F., Joyce, C., Scanlan, A., & Cripps, A. (2021). A comparison of multidimensional qualities discriminant of selection in elite adolescent Australian basketball athletes. *Plos one*, *16*(8), e0256032.
- Kelly, G. A., Jackson, T. T., Zelhart, P. F., & Markley, R. P. (1985). *The Handbook of Clinic Practice*.
- Koopmann, T., Faber, I., Baker, J., & Schorer, J. (2020). Assessing technical skills in talented youth athletes: a systematic review. *Sports Medicine*, *50*(9), 1593-1611.
- Larkin, P., & O'Connor, D. (2017). Talent identification and recruitment in youth soccer: Recruiter's perceptions of the key attributes for player recruitment. *PLOS one*, *12*(4), e0175716.
- May, L. (1998). *Masculinity & morality*. Cornell University Press.
- Naremore, J., & Brantlinger, P. M. (Eds.). (1991). *Modernity and mass culture*. Indiana University Press.
- Oliveira, J. P., Marinho, D. A., Jacinto, P., Sampaio, T., & Morais, J. E. (2025). Characterization of physical performance and change of direction deficit across age groups in young female volleyball players. *BMC Sports Science, Medicine and Rehabilitation*, *17*(1), 209.
- Phoutchanthavongsa, S. (2019). *Lesbian, gay, bisexual, and transgender (LGBT) disclosure among the Global Fortune 250 companies—An exploration* (Doctoral dissertation, Auckland University of Technology).
- Pino-Ortega, J., Rojas-Valverde, D., Gómez-Carmona, C. D., & Rico-González, M. (2021). Training design, performance analysis, and talent identification—A systematic review about the most relevant variables through the principal component analysis in Soccer, Basketball, and Rugby. *International Journal of Environmental Research and Public Health*, *18*(5), 2642.
- Roberts, E. M. (1949). *Mental health clinical services; a study of the children between 6 and 12 years of age examined by mental health clinics in Vancouver from 1945 to 1947 inclusive* (Doctoral dissertation, University of British Columbia).
- Rubajczyk, K., & Rokita, A. (2020). The relative age effect and talent identification factors in youth volleyball in Poland. *Frontiers in Psychology*, *11*, 1445.
- Sagalyn, L. B. (2003). *Times Square roulette: Remaking the city icon*. MIT Press.
- Sarmiento, H., Anguera, M. T., Pereira, A., & Araújo, D. (2018). Talent identification and development in male football: A systematic review. *Sports medicine*, *48*(4), 907-931.

-
- Satloff, R. (2004). *The battle of ideas in the war on terror*. Washington, DC: Washington Institute for Near East Policy.
- Sgrò, F., Quinto, A., Lipoma, M., & Stodden, D. (2024). A multidimensional approach to talent identification in youth volleyball through declarative tactical knowledge and functional fitness. *Journal of Functional Morphology and Kinesiology*, 9(1), 29.
- Smith, S. W. (1986). *The segregation of girls in mathematics*. Sheffield Hallam University (United Kingdom).
- Sodaitis, B. (2020). *Relation between anthropometric, physical, technical testing and game-related statistics in youth basketball players* (Doctoral dissertation, Lietuvos sporto universitetas.).
- Tornatore, G. (2013). *Becoming a "jazzperson": Moving beyond sounds and tones* (Doctoral dissertation, Teachers College, Columbia University).
- Tsoukos, A., Drikos, S., Brown, L. E., Sotiropoulos, K., Veligeas, P., & Bogdanis, G. C. (2019). Upper and lower body power are strong predictors for selection of male junior national volleyball team players. *The Journal of Strength & Conditioning Research*, 33(10), 2760-2767.
- Wang, F. Y. (2024). *The art of state persuasion: China's strategic use of media in interstate disputes*. Oxford University Press.
- Warren, A. (1993). *Urban Regeneration in the 1990s: A review of the City Challenge initiative*. University of London, University College London (United Kingdom).
- Williams, A. M., Ford, P. R., & Drust, B. (2023). Talent identification and development in soccer since the millennium. *Science and football*, 3-14.
- Zemková, E., & Hamar, D. (2018). Sport-specific assessment of the effectiveness of neuromuscular training in young athletes. *Frontiers in physiology*, 9, 264.