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A Comparative Study of Anthropometric Parameters in Relation to Performance of Volleyball and Basketball Players Selected at Different Levels of Participation: A Comprehensive Review Study

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Abstract
This review study seeks to determine the relative importance of some anthropometric parameters between volleyball and basketball players at different competitive levels (inter-school, inter-university, state) participating in sports team. The analysis will provide insight on sport-specific performance parameters such as jumping, sprinting and upper body power in relation to anthropometry (e.g., height, Body Mass Index [BMI], segmental limb lengths and circumferences). Volleyball and basketball may have the same team sport structure, but performances of both sports are not similar in terms of physical demand leading to profile comparisons depending on performance characteristic. The review uses a qualitative synthesis of recent Indian and some charged international studies that have been published in 2020-25 with respect to context appropriateness. Findings consistently reveal volleyball players are taller, have longer lower and upper limbs, and lower BMI characteristics associated with superior jumping performance and agility that are important for net-based play. On the basketball side of things, players have bigger thigh and calf muscles, wider shoulders and higher BMIs that come into play with sprinting, crash boarding (rebounding) and grinding down low (strength). Studies also indicate that players competing at higher levels of participation display more individualized sport-specific anthropometric characteristics, suggesting the marked contribution of training specifics and physiological selection. This study highlights the utility of anthropometric-based profiling for athlete identification, performance enhancement and injury risk mitigation. The results support the importance of incorporating this factor into India's sport development systems to promote evidence-based training, early talent identification and long-term athletic development. It adds to the current practical applications of theory in sports and provides theoretical basis for further development of recruiting strategies and normative data for Indian volleyball and basketball players.

Keywords: Anthropometric measurements, volleyball, basketball, performance analysis, limb proportions

Introduction
Anthropometry is a basis of contemporary sport science and involves the measurement of physical elements of body size and composition. It provides valuable insight in physiological performance levels at which athletes are able to perform, and for which type of sport they are suited. Basketball and volleyball are dynamic and space-dependent team games requiring characteristic anthropometric traits, which may have an effect on selection, training processes, as well as players' performance. With the growing attention to talent identification and performance enhancement, specifically in the Indian context, comparative determinant of anthropometry among these sports has become one of necessary avenues for analysis in recent years. Among the anthropometric characteristics in volleyball and basketball, height is probably the most floridly evident with the most importance. It also offers a direct competitive advantage in both sports namely when performing acts such as blocking, spiking, rebounding and dunking. Volleyball players are typically chosen for their elevated height and long arm span, which have the effect of making it easier to block the ball. Volleyball players from Indian universities were taller with longer total arm span than basketball players which facilitated better net play as shown by Gaurav, Singh and Singh (2022) [15]. Athletes in basketball, depend on not only height but also BMI, shoulder girth

and upper body strength for contact play, balance control and power developments for lay-ups movements post playing actions.

Body Mass Index (BMI) derived from height and body weight is an important parameter of overall body composition. A normal BMI may actually just be muscle on basketball players, particularly in the upper body that has used a lot for protection, shooting and rebounding. In contrast to football, volleyball players have slightly lower BMI values where the emphasis is placed on lean skeletal muscle mass rather than overall bulk with respect to agility and vertical jump. Miguel-Ortega, Calleja-González, & Mielgo-Ayuso, found similar results in elite female volleyball players when compared to basketball when it comes to body weight where the former had a lower BMI as a means of their lighter body structure and greater kinanthropometric agility.

Another factor, total leg length, is an influencing factor of stride length, vertical leap and left to right stepping velocity. Volleyball Middle blockers and outside hitters benefit from longer legs which enable higher spiking reach and well increased jumps. in a study which compared Serbian youth players, volleyball players were found to have significantly longer thigh (upper leg) length and shorter lower leg when conducting comparisons with anaerobic abilities of vertical jump. Basketball players (particularly guards) apply leg power for sprint bursts and now we have rapid path adjustments. The leg is broken down into the thigh and lower leg in different capacities in each sport. Thigh and lower leg circumferences represent the distribution of muscle mass, which is important in actions of explosive performance (i.e. jumping or sudden acceleration).

Shoulder circumference is relevant for various types of martial arts, especially for basketball players who must have stable hands to throw and rebound. Additionally, during considerable collisions, broader shoulders might improve balance. Volleyball players also acquire solid shoulders for constant spiking and blocking. However, their post-exercise regimen frequently includes expansion with counseling from power coaching. In their study, Nagarajan, Khan, and MK determined the university study conducted in India in 2024 indicated that basketball players had more excellent shoulder and knee girth, indicating that muscles were more prominent and could handle more physical activity during the game. Arm length is vital in both martial and ball sports. In volleyball, offensive and defensive movements rely on arm length. In basketball, the arms must be even shorter to ensure a competitive advantage when throwing and rebounding the ball. The shoulder can be split into the upper arm length and the lower arm length to evaluate appropriate leverage. Peña, Moreno-Doutres, Coma, and Cook discovered that individual volleyball players maintained a short upper arm length and a more extended lower arm length. This strategy guarantees immediate response and coverage in the tenth message. Both players in the martial sport leagues have a relatively long arm but basketball athletes also utilize arm power for jabbing the ball and taking the golf ball under control to get to the rim.

The circumference of the knee and calf reflect lower extremity muscle development and stability. In basketball, there is a lot of pivoting and lateral cuts and hard stops all need strong knee and calf muscles. Volleyball on the other hand, requires a lot of flexibility in terms of knees and stamina to be able to tolerate the repetitive jumping involved. Indian investigators like Barut, Demirel, and Kıran have reported that volleyballers possess leaner but more 'springy' calves that facilitate repeated jumping without loss of fatigue. By contrast, basketball players tend to have more hypertrophied calves and knees that provide power for quick bursts and fast take-offs.

Thigh size is equally important not only for sport but also indication for quadriceps and hamstring development. In volleyball, well developed thigh muscles are critical to jumping and strong lifts off the floor for hits and serves. Thigh strength is vital for rebounding, fast breaks and jumping to contest shots on the basketball court. García-Gil, Torres-Unda and Esain (2023) [13] find that thigh circumference is positively associated with jumping force and acceleration in basketball players. Volleyball players also need well-muscled thighs to perform multiple consecutive jumps over and over with endurance.

Most importantly, these body dimensions are not independent but instead work together to enhance the performance of an athlete. The ratio of height, arm span and shoulder width determines the spatial control athletes have and play domination. The addition of leg length, thigh girth and lower extremity circumferences contributes to maximizing thrust, stability and jump height. Each anthropometric variable has particular relevance in sport and position. For instance, while a libero does not need to be the tallest athlete on the volleyball court, a middle blocker does. Contrast At basketball, point guards are more likely to need nimbleness and speed of foot than height categorisation as the position tends to do with arm length and shoulder breadth for centres.

Second, in the era of increasing organization of sports in India and growing participation levels from an inter-school to elite national level, there is a dire need to scientifically document how anthropometric variables differ at various stages of participation. With reference to the work of Popovic, Bjelica, & Jaksic (2020) [14] on Balkan athletes, it is clear that elite competitors tend to demonstrate near ideal anthropometric profiles that are often closely associated with performance requirements.

The Indian model of sports promotion has been oriented historically towards high level skill attainment as opposed to “body build” and hence, there is a need for adding the components of anthropometric testing for early screening. This investigation will attempt to bridge this gap by also presenting comparative data of volleyball and basketball players with regards to various levels of competition. It also makes possible an evidence-based athlete profile, which takes into account specific anthropometric characteristics such as height, BMI, sum of limb length and circumferences to assist coaches/trainers in sport-specific planning.

Through broadening research to each measurement of anthropometric and its sport specific relevance, the present study brings a theoretical significance but also practical value of applicability in talent development programs, particularly in context of Indian sporting system. This research also provides a baseline to facilitate future studies of gender disparity, regional variations on anthropometry, and longitudinal athlete progression across sports.

Review of Literature

Jeevanandham and Karthikeyan (2020) [2] investigated Indian university level athletes, and found that volleyball players demonstrated significantly higher height, total leg

length which might aid in enhancing jump performance in them. On the other hand, basketball players demonstrated higher shoulder and thigh circumferences associated with explosive power. Kumar and Rajasekaran (2021) [5] studied anthropometry variations between college players of Tamil Nadu. It was observed that volleyball players had long arms and legs which can be advantageous in terms of spiking and blocking, while basketball players possessed broader shoulders & higher BMI indicative for strength related play. Prakash and Venugopal (2021) [8] investigated sub-elite athletes, and observed that basketball players had higher body mass index (BMI) along with calf circumference, which are related to superior sprint power/speed as well as endurance capabilities. Volleyball players had lower body fat percentages combined with an increased arm reach appropriate to air skill performance. Vishwakarma and Singh (2022) [12] who compared somatotype and anthropometry of intercollegiate players however they reported volleyball players to be more ectomorphic with longer lower limbs and smaller girths. Basketball players were mesomorphic, where increases in knee and thigh circumferences contributed to their strength abilities and acceleration. Nayak and Murthy (2022) [7] investigated anthropometric profiles of North Indian players reveled that volleyball players had greater leg length: torso ratio than other players as well low BMI to inculcate jumping related activities. Basket ballplayers had more upper hypertension muscle mass, and the shoulder girth was larger. Ravikumar and Elangovan (2022) [9] in their study on physical and kinanthropometric differences found physical and kinanthropometric differences between sports players who, according to the authors, differed significantly in upper arm length of volleyball players were longer when compared to basketball players, as well they mean thigh length than basketball per se which means better for dynamic lower body strength.

Das and Mishra (2023) [1] studied the efficiency of the vertical jump in term of limb segment. The study revealed that volleyball players could benefit from elongated lower leg lengths and slender figure, whereas basketball players had an advantage from larger thigh circumference and higher BMI. Khan and Narayanan (2023) [4] studied agility and anthropocentricity correlation in team games. The research found that basketball players excelled more in sprint and agility tests, which were linked to a broader knee and shoulder circumference. Volleyball players were superior in vertical jump as a result of longer arms and legs. Nagarajan, Khan and MK (2024) [6] performed a comparative study in Indian universities and found that basketball players possessed better UP girths, shoulder circumference and BMI which helps player to perform under physical stress. Volleyball players displayed longer lower legs and superior balance. Kaur and Dutta (2024) [3] on the morphological predictors of performance, showed significantly longer arm and lower leg segments in Volleyball players. Basketball players had a greater knee and thigh girth and their anthropometry accommodated for an explosive lower limb power.

Srivastava and Mehta (2025) [10] in elite Indian athletes also concluded that volleyball forces repeatedly depended on height and leg length for performance whereas, basketball players demonstrated of having higher BMI, shoulder width and thigh girth corroborating their sport specific demands. Verma and Joshi (2025) [11] compared players of three different game involvement levels, and reported greater standing height and longer segmental dimensions in volleyball players. Basketball but with basal greater girths in thighs and calves, which would predispose to contact activities.

Significance of the Study

This study has a great significance in theoretical as well as practical fields of sports sciences, especially in the context of India where anthropometric profiling is yet to emerge into a tool for talent identification and sports specialization. With a spotlight on volleyball and basketball - two sports that are gaining in popularity at the scholastic, university and professional levels of play - those involved in training now have a measurable way to understand how certain body measurements can affect their success. In this case height and full arm length are very important in vertical dominance for both basketball and volleyball. In volleyball, these characteristics are important for spiking, blocking and touching the net. As in basketball, the longer lever arm of upper limbs is also to a certain extent beneficial in cricket bowling. Equivalently, BMI is crucially involved in the maintaining of muscle and fat balance. For instance, it may be the case that lower BMI can provide an advantage to soccer and volleyball players because of their need for agility and leanness but higher laser -measured BMI in basketball players could reflect more muscle mass contributing to strength or stance ability.

The emphasis in the study on leg length components—total leg length, and thigh and lower leg length are key for assessing jumping ability and explosive movement fundamental to both sports. A proxy for muscle hypertrophy and endurance, most thoracic limbs showed a particularly enhanced muscularity. Girth around the shoulder and knee represent muscularity and joint robustness, which is important in terms of blocking, rebounding, and rapid change of direction. In a country like India, which continues with the traditional method of coaching heavily depending on on-technical based drills without enough biometric profiling, this research will stand as a bridge of the gap between science and practice. Coaches, sports academies and recruiters can use this data to customise training programmes and scout athletes that physiologically fit their requirements, while minimising injury risk when knowing the limits of a player's structure. Further, if the studies have a large enough enrollment, will help in creation of normative data for Indian athletes at different level and types of sports which can be utilized to build long term athlete development (LTAD) models.

Objectives

The primary aim of this review is to compare key anthropometric parameters—such as height, BMI, limb lengths, and limb circumferences—between volleyball and basketball players across different competitive levels. The study seeks to determine how these variables relate to sport-specific performance, including jumping, sprinting, and strength-based actions. It also explores the relevance of these physical traits in predicting performance potential, aiding in athlete selection and training within the Indian context.

Methodology

The review was conducted using a structured qualitative method and included both contemporary Indian and selected global studies published during 2020 to 2025. The literature

was searched from academic databases based on a comparative study between volleyball vs. basketball players regarding anthropometry. Results following are general summaries with themes extracted from the results regarding height, BMI, limb segment lengths and girths. Prioritization was given to studies that included inter-school, university and state-level athletes, so as to have a relevant level of performance and contextual richness.

Findings

The findings of this review study showed that there were remarkable anthropometric differences in players of volleyball and basketball, which reflects the differential physical demands of these sports. Volleyball players are also taller and have longer total and lower leg lengths, but they tend to have lower BMI. These attributes lead to increased vertical jumping ability, agility at the net and control of lower limb movement during jump-landing actions. Not so among basketball players who are on average taller, have greater BMI and larger shoulder breadths, calf and thigh circumferences. These qualities will help an athlete with explosive strength and stability in physical encounters or acceleration during changes of direction. Volleyball players had longer upper extremities enabling better reach for the block and spike; basketball players had larger girths of the upper arm and shoulder promoting shooting over head, as well as rebounding among opponents. Consistent patterns across segments existed at all the participation levels, and the state/elite level players demonstrated a more differentiated sport specific morphological adaptation compared to those from inter-school/university level.

Discussion of Results

The study results show a strong correlation between sport-specific anthropometric characteristics and player performance level in volleyball and basketball. For instance, Jeevanandham and Karthikeyan (2020) [2] found that university-level volleyball players had a better height and leg length, leading to their vertical jump performance, but basketball players presented higher thigh and shoulder circumferences for explosive power. It was reported by Kumar and Rajasekaran (2021) [5] as well that volleyball players have longer limbs which is favorable in net play delivering the ball, while basketball players presented wider shoulders and higher BMI to afford strength-oriented gameplay. Additionally, Prakash & Venugopal [8] have substantiated that the volleyball players possessed low fat and more reach, whereas basketball players had higher development of calf muscles with BMI so as to gain grip for better sprinting and endurance. Vishwakarma and Singh (2022) [12] also revealed that volleyball players were ectomorphic, possessing longer limbs and slender body shape while the basketball players were mesomorphic; measured as greater girth around knees and thighs contributing to strength and power.

Nayak and Murthy (2022) [7] repeated these findings, noting that volleyball athletes sported more thigh-to-torso ratios conducive to jump-based performance than basketball players, who in turn betrayed more upper-body muscle mass. Ravikumar and Elangovan (2022) [9] also documented longer upper arms and thighs, as well as larger calf girths for the former group of players versus a rather accentuated medial thigh and calf girth among basketball players supporting their high-contact game playing style. Das and Mishra (2023) [1] found that lower leg length, lean body mass had a positive impact on jumping performance of volleyball; whereas basketball players' benefit from larger thigh girths. Khan and Narayanan (2023) [4] underscore that physical traits correlate with agility, evidencing that length of limbs were optimal in volleyball players for vertical jumps; in contrast basketballers had wider knees and shoulders conducive to dynamic movement. Nagarajan, Khan and MK (2024) [6] also confirmed the fact that basketball players have bigger upper limb girths and shoulder circumferences which is due to muscular endurance comparing to volleyball players who had long limbs and balance advantages. These results were also corroborated by Kaur and Dutta (2024) [3] who associated longer lower limbs in volleyball players to explosive jump performance, and stronger thigh and knee girths in basketball players with greater lower-body strength. Finally, Verma and Joshi (2025) [11] and Srivastava and Mehta (2025) [10] emphasized the superior morphological adaptations found in higher-level athletes, taller volleyball players with more linear builds while higher muscularity but less longitudinal length of basketball ones should facilitate their sprinting, twisting and turning and rebounding.

Therefore, these comparisons show that anthropometric traits are not only biological characteristics but also relevant performance factors influenced by the nature of the sport and competitive level. Through Indian researches but it is consistently observed that the volleyball requires tall and long limbs, while basketball has muscle mass and body weight for power production. Being aware of the differences may significantly affect player scouting, training design and performance priority.

Conclusion and Implications

This review the impact of anthropometric factors in modifying performance outcomes on the volleyball and basketball fields concludes that, directly or indirectly, height, body mass and limb lengths or circumferences are determinants that relate to performance indices in volleyball and basketball. Volleyball players tend to be taller, longer and leaner which contributes to being able to perform vertical feats such as blocking, spiking and net dominance. However, basketball players enjoy higher BMI, more powerful upper/lower limbs girths and wider frames to help in sprinting, rebounding and physical game. This review supports that players at the highest-level competition demonstrate sport-specific anthropometric adaptations related to training and or selection pressures.

From a practical standpoint, these results have significant application for Indian coaches, physical trainers and sports administrators. Individual physique profiles need to be considered in aspect of selection and training programme design, keeping into account the requirements of a specific sport. This method might get the better talent scouting at initial levels such as under school and college systems, where scouting is very pathetic. In addition, normative anthropometric values for Indian athletes can be significant in modifying standards for physical development for volleyball and basketball. This integration would facilitate LTAD and lower the risk of injury by matching body type with biomechanical efficacy. The lessons from this study eventually call for a scientific and evidence-based approach to athletic development in Indian team sports.

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