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Physical And Anthropometric Factors Influencing Vertical Jump In Volleyball : Literature Review

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ABSTRACT

Vertical jump ability is one of the most important performance indicators in volleyball because it directly supports spiking and blocking effectiveness during competition. Optimal jump performance is influenced by various factors, particularly physical and anthropometric characteristics that contribute to explosive movement production and biomechanical efficiency. However, findings regarding the dominant factors affecting vertical jump performance remain varied across previous studies. Therefore, this study aimed to analyze the physical and anthropometric factors influencing vertical jump performance in volleyball athletes through a literature review approach. This study employed a literature review design using secondary data obtained from scientific publications, including reputable national and international journals related to sports science, volleyball performance, physiology, biomechanics, and anthropometry. The data collection process involved identifying, reviewing, and synthesizing relevant research findings published within the last ten years. The selected studies were analyzed descriptively and critically to identify the dominant variables influencing vertical jump performance. The findings revealed that physical factors demonstrated a more dominant influence on vertical jump performance compared to anthropometric factors. Lower limb muscle strength and explosive power consistently showed significant contributions to jump height through neuromuscular force production mechanisms. Maximal strength and training activity also contributed positively, although their effects depended on training specificity and program quality. From an anthropometric perspective, body weight and leg length influenced jump performance through biomechanical mechanisms; however, their effects were generally supportive rather than dominant. In conclusion, vertical jump performance in volleyball is determined by the interaction between physical and anthropometric factors, with neuromuscular capacity serving as the primary determinant. Therefore, volleyball training programs should prioritize explosive power and lower limb strength development supported by optimal body composition management.

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INTRODUCTION

Volleyball is one of the most widely practiced and popular sports worldwide, including in Indonesia, where it is played competitively and recreationally across different age groups and educational levels. Volleyball contributes not only to physical fitness improvement but also to athlete performance development and psychosocial well-being. The dynamic nature of volleyball requires athletes to perform explosive and repetitive movements such as jumping, landing, sprinting, diving, blocking, and spiking during matches and training sessions. These demands place a significant emphasis on athletes' physical preparedness and biomechanical efficiency. Recent studies have shown that success in volleyball is strongly associated with technical mastery, tactical understanding, and physical performance capacity, particularly lower-body explosive power and vertical jump ability (Castro et al., 2022; Giatsis & Tilp, 2022; Latino et al., 2024). Among the essential techniques in volleyball, spiking and blocking are considered the most decisive offensive and defensive actions in determining match outcomes. Spiking serves as the primary attacking strategy to generate points and pressure opponents' defensive systems, while blocking functions to prevent or reduce the effectiveness of opposing attacks (Raihanati & Wahyudi, 2021). Both techniques require athletes to jump vertically at maximum height with optimal timing and coordination. Consequently, vertical jump performance has become one of the most critical indicators of volleyball performance (Pawlik & Mroczek, 2023). Athletes with superior vertical jump capacity generally demonstrate greater spike power, wider blocking reach, and improved overall game effectiveness.

Vertical jump performance reflects the ability of the neuromuscular system to produce maximal force in a short duration through explosive extension of the hip, knee, and ankle joints. This movement pattern involves complex interactions between muscle strength, muscle power, coordination, tendon stiffness, and biomechanical efficiency (Zhao et al., 2021). Previous investigations have identified several physical determinants of vertical jump ability, including lower limb muscle strength, explosive power, agility, sprint ability, balance, and flexibility (Cabarkapa et al., 2025). In addition, anthropometric characteristics such as body height, body mass index, limb length, body composition, muscle mass, and age also contribute to jump performance outcomes (Alvero-Cruz et al., 2021). Despite the growing number of studies investigating vertical jump determinants in volleyball athletes, the findings remain inconsistent and fragmented. Some studies emphasize the dominance of physical conditioning variables, while others report stronger contributions from anthropometric characteristics. Moreover, differences in research design, athlete level, testing instruments, sample size, gender, and playing position have generated variations in conclusions across the literature. This condition creates difficulties for coaches, sports scientists, and practitioners in identifying the most influential factors affecting vertical jump performance in volleyball athletes. Therefore, a comprehensive literature review is necessary to synthesize existing evidence regarding physical and anthropometric factors influencing vertical jump performance in volleyball. Such synthesis is important to provide clearer scientific understanding, strengthen theoretical frameworks, and support evidence-based training programs aimed at improving volleyball performance.

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Recent developments in sports science have increasingly emphasized the importance of multidimensional approaches in evaluating athletic performance. In volleyball, vertical jump ability is considered a key biomotor component associated with match success and athlete competitiveness. Several contemporary studies have explored the physiological, biomechanical, and anthropometric determinants associated with jumping performance in volleyball athletes. Physical factors have consistently been identified as dominant contributors to vertical jump performance. Explosive muscle power, particularly in the quadriceps, hamstrings, gluteal muscles, and calf muscles, plays a central role in generating vertical propulsion force during jumping movements (Cabarkapa et al., 2025). Plyometric training interventions have demonstrated significant improvements in vertical jump performance due to enhanced neuromuscular adaptations, stretch-shortening cycle efficiency, and motor unit recruitment (Ramirez-Campillo et al., 2020). Similarly, resistance training programs focusing on maximal strength development have been shown to improve force production capacity and jumping efficiency among volleyball players (Loturco et al., 2021). Muscle strength and power are not the only determinants influencing jump performance. Agility, sprint speed, coordination, and flexibility have also been reported to correlate positively with vertical jump outcomes. Athletes with superior lower-body coordination and dynamic balance tend to exhibit more efficient force transfer during take-off movements (Markovic & Mikulic, 2020). In addition, joint mobility and flexibility contribute to optimal movement amplitude and reduced biomechanical restrictions during explosive actions (Okta et al., 2023).

From an anthropometric perspective, body height and limb length are frequently associated with volleyball performance because taller athletes possess greater reach advantages during blocking and attacking actions. However, greater body height alone does not automatically guarantee superior jump performance without adequate physical conditioning (Pawlik & Mroczek, 2023). Studies have also demonstrated that lean body mass and lower body fat percentage positively influence vertical jump ability by improving power-to-weight ratio and movement efficiency (Alvero-Cruz et al., 2021). Conversely, excessive body mass may negatively affect explosive movements and jumping mechanics. Current research has also highlighted positional differences in anthropometric and physical characteristics among volleyball players. Middle blockers and opposite hitters generally demonstrate greater body height and jumping reach compared with setters and liberos due to positional demands (Giatsis & Tilp, 2022). Furthermore, elite volleyball athletes often exhibit superior neuromuscular performance, muscle architecture adaptations, and optimized body composition compared with sub-elite or amateur athletes (Latino et al., 2024).

Advances in testing technology have further contributed to vertical jump research. Modern assessment tools such as force plates, contact mats, wearable sensors, and motion analysis systems allow researchers to evaluate jump kinetics, kinematics, and neuromuscular performance with greater accuracy (Zhao et al., 2021). These technological developments have improved understanding of the biomechanical mechanisms underlying successful jumping performance in volleyball. Collectively, previous studies indicate that vertical jump ability in volleyball is influenced by an interaction between physical

conditioning and anthropometric characteristics. However, the relative contribution of each factor remains a topic of ongoing scientific discussion.

Although numerous studies have investigated vertical jump performance in volleyball athletes, several important gaps remain within the current body of literature. First, many previous studies have focused only on isolated variables such as lower limb power, strength, or body height without integrating physical and anthropometric factors simultaneously. As a result, the interaction between these variables and their combined contribution to vertical jump performance has not been comprehensively explained. Second, previous investigations often employ heterogeneous methodologies, including differences in participant characteristics, training status, age groups, gender, playing positions, and testing protocols. Such methodological variability has produced inconsistent findings regarding which variables exert the strongest influence on vertical jump performance. Some studies identify anthropometric characteristics as dominant predictors, whereas others emphasize physical conditioning variables. Third, most existing studies are experimental or correlational in nature and are limited to specific athlete populations or regional contexts. Comprehensive literature review studies synthesizing evidence across multiple research findings remain relatively limited, particularly within volleyball-specific contexts. Consequently, coaches and practitioners still lack integrated evidence-based guidance regarding the primary determinants of jumping performance in volleyball athletes. Fourth, limited literature specifically discusses the interaction between anthropometric characteristics and trainable physical capacities. Anthropometric variables are generally considered non-modifiable, whereas physical capacities such as strength and power can be improved through systematic training programs. Understanding the balance between these factors is essential for talent identification, athlete development, and training program design. Finally, there is still insufficient discussion concerning practical implications for coaches and sports practitioners in translating scientific findings into volleyball training strategies. Many previous studies remain theoretical and fail to provide clear recommendations for athlete conditioning programs aimed at optimizing vertical jump performance.

Based on the identified problems and research gaps, this study aims to analyze and synthesize scientific evidence regarding the physical and anthropometric factors influencing vertical jump performance in volleyball athletes through a literature review approach. This study seeks to identify the most dominant determinants affecting jumping ability and to explain the relationship between physical capacities and anthropometric characteristics in volleyball performance contexts. The novelty of this study lies in its integrative approach that combines both physical and anthropometric perspectives within a single comprehensive review framework. Unlike previous studies that generally focus on isolated variables, this review critically evaluates multidimensional factors influencing vertical jump performance, including muscle strength, explosive power, flexibility, agility, body composition, body height, and limb dimensions. In addition, this study provides a contemporary synthesis of findings from reputable national and international journals published within the last decade, thereby offering updated scientific insights relevant to current volleyball performance demands. This review also emphasizes practical

implications for coaches, athletes, and sports scientists in designing evidence-based conditioning programs, talent identification systems, and athlete monitoring strategies.

Furthermore, this study contributes theoretically to the development of sports science literature by clarifying the interaction between trainable physical capacities and relatively fixed anthropometric characteristics in determining vertical jump performance. Practically, the findings are expected to serve as scientific references for improving volleyball athlete development programs and optimizing competitive performance outcomes. In conclusion, vertical jump performance in volleyball is influenced by complex interactions between physical conditioning factors and anthropometric characteristics. Understanding these multidimensional determinants is essential for enhancing athlete performance, improving training effectiveness, and supporting evidence-based coaching practices. Therefore, this literature review is expected to provide comprehensive scientific contributions for the advancement of volleyball performance research and sports science development.

METHODS

This study employed a literature review design to systematically analyze and synthesize scientific evidence regarding the physical and anthropometric factors influencing vertical jump performance in volleyball athletes. A literature review approach was selected because it enables researchers to comprehensively evaluate, compare, and integrate findings from various empirical studies related to a particular topic, thereby generating broader theoretical understanding and evidence-based conclusions (Snyder, 2019). In sports science research, literature reviews are frequently used to identify dominant performance determinants, evaluate methodological trends, and formulate practical implications for athlete development and training programs (Paul & Criado, 2020). The review process was conducted systematically following general principles adapted from the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework to ensure transparency, consistency, and scientific rigor throughout the data collection and selection stages (Page et al., 2021). Several reputable electronic databases were utilized to obtain relevant scientific publications, including Google Scholar, Scopus, PubMed, ScienceDirect, and Taylor & Francis. These databases were selected because they provide extensive access to peer-reviewed journals in sports science, biomechanics, physiology, and anthropometry. The literature search was conducted using several combinations of keywords and Boolean operators to maximize the relevance of retrieved studies. The primary keywords included "vertical jump," "volleyball athletes," "physical factors," "anthropometric factors," "explosive power," "body composition," "muscle strength," and "jump performance." Boolean operators such as AND and OR were applied to refine the search strategy and improve database accuracy (Xiao & Watson, 2019). The search process focused on articles published between 2015 and 2025 to ensure the inclusion of recent scientific evidence and contemporary developments in volleyball performance research.

The inclusion criteria for article selection were established to maintain the quality and relevance of the reviewed literature. Studies were included if they: (1) investigated

volleyball athletes or physically active populations relevant to volleyball performance; (2) examined physical factors such as strength, power, agility, flexibility, or neuromuscular performance related to vertical jump ability; (3) analyzed anthropometric characteristics including height, body mass, body composition, limb length, or muscle mass; (4) were published in reputable national or international journals indexed in SINTA or Scopus; and (5) used quantitative, experimental, correlational, or observational research designs. Meanwhile, studies were excluded if they were conference abstracts, editorials, duplicate publications, non-English articles without adequate scientific information, or studies unrelated to vertical jump performance. After the identification process, all retrieved articles underwent screening and eligibility assessment based on titles, abstracts, and full-text evaluation. The selected studies were then analyzed descriptively and critically to identify similarities, differences, methodological characteristics, and major findings related to vertical jump determinants. According to Grant and Booth (2019), critical synthesis is essential in literature reviews because it allows researchers to evaluate evidence quality and identify research gaps within a scientific field.

Data extracted from the selected studies included author names, publication year, sample characteristics, research design, assessment instruments, physical variables, anthropometric variables, and major findings regarding vertical jump performance. The extracted data were organized into thematic categories to facilitate comparative analysis and conceptual interpretation (Thomas et al., 2020). Narrative synthesis was subsequently employed to integrate findings across studies and explain the interaction between physical and anthropometric factors affecting volleyball athletes' jumping performance. To strengthen the validity and reliability of the review findings, only peer-reviewed articles from reputable scientific journals were included in the analysis. Furthermore, the interpretation of findings emphasized consistency across empirical evidence and contemporary sports science theories concerning neuromuscular performance, biomechanics, and athlete anthropometry (Ramirez-Campillo et al., 2020; Loturco et al., 2021). Through this methodological approach, the present literature review is expected to provide comprehensive and evidence-based insights regarding the multidimensional factors influencing vertical jump performance in volleyball athletes.

RESULTS AND DISCUSSION

Result

The findings of this literature review demonstrate that vertical jump performance in volleyball athletes is influenced by a combination of physical and anthropometric factors. Based on the analysis of previous empirical studies published within the last decade, physical factors generally showed stronger and more consistent relationships with vertical jump performance compared to anthropometric characteristics. However, anthropometric variables also contributed significantly to jump efficiency and biomechanical advantages during volleyball performance.

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Physical Factors Influencing Vertical Jump Performance

Several reviewed studies identified muscle strength as the most dominant physical factor influencing vertical jump ability. Maximum strength showed a statistically significant relationship with vertical jump height, as indicated by partial test results of 0.002 < 0.005 (I. Setiawan et al., 2025). These findings suggest that athletes with greater force production capacity tend to achieve higher jump performance due to improved neuromuscular recruitment and explosive extension during take-off movements. In addition, lower limb muscle strength and abdominal muscle endurance were found to simultaneously influence jump performance with a combined contribution of 36.1% (Masrur, 2025). Nevertheless, abdominal endurance demonstrated a smaller contribution compared to leg muscle strength, indicating that core endurance mainly functions as a supporting component for movement stability rather than as the primary determinant of jump height. Interestingly, other studies revealed that back muscle strength contributed more significantly to vertical jump performance than leg muscle strength. This was supported by statistical findings showing rcount = 0.975 > rtable = 0.632 at a 5% significance level (Pamungkas & Nidomuddin, 2021). These findings indicate that vertical jumping performance is not solely dependent on lower limb musculature but also requires adequate trunk stability and upper-body coordination to optimize force transfer throughout the kinetic chain.

Training activity also demonstrated a positive relationship with vertical jump ability. According to Kurniasandi (2022), athletes with higher training intensity and frequency showed better jump performance, with a correlation coefficient of 0.680 and significance value of 0.000 < 0.05. However, the moderate correlation level indicates that training alone cannot fully explain vertical jump performance without considering individual physiological and biomechanical characteristics. Furthermore, studies evaluating anaerobic capacity and power showed inconsistent findings. Atik and Badilli (2024) reported that general anaerobic capacity did not always significantly correlate with vertical jump performance, suggesting that vertical jump relies more heavily on specific explosive strength rather than generalized anaerobic endurance. Similarly, not all resistance training methods consistently improved jump height, indicating that exercise specificity plays a crucial role in performance enhancement (N. Hidayat, 2023). Among the reviewed training interventions, plyometric training emerged as the most effective method for improving vertical jump performance. Plyometric exercises significantly enhanced lower limb explosive power and neuromuscular efficiency, resulting in substantial improvements in vertical jump height (Zubaidah et al., 2025). These findings reinforce the importance of stretch-shortening cycle adaptations in volleyball-specific jump training.

Anthropometric Factors Influencing Vertical Jump Performance

Anthropometric variables also demonstrated important contributions to vertical jump performance, although the relationships varied depending on the measured variable. Body weight exhibited a very strong negative relationship with vertical jump performance (P. R. M. I. Setiawan, 2025). Excessive body mass was identified as a biomechanical limitation that increases gravitational load and reduces movement efficiency during explosive jumping actions. Similarly, Body Mass Index (BMI) was found to influence vertical jump efficiency,

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particularly through the relationship between body mass and muscle strength ratio (Sutralia et al., 2025). Athletes with lower fat mass and greater lean muscle composition generally demonstrated better jumping performance due to improved power-to-weight ratio. Leg length showed a positive and significant relationship with vertical jump height. Marbun (2020) reported statistical findings of tcount = 3.62 > ttable = 1.711, with a contribution potential reaching 52%. Longer lower extremities may provide biomechanical advantages through greater leverage and force application during jumping movements. However, anthropometric advantages alone were insufficient without adequate muscular strength and technical proficiency. Conversely, arm length and leg length demonstrated only weak direct relationships with vertical jump height according to Nasuka and Priambodo (2017). Although these variables may not directly improve jump elevation, they contribute substantially to reach effectiveness during spiking and blocking actions in volleyball competitions.

The overall findings indicate that physical factors, particularly muscle strength, explosive power, and training specificity, contribute more consistently to vertical jump performance than anthropometric characteristics. Nevertheless, anthropometric variables such as body composition and limb dimensions remain important supporting factors that influence biomechanical efficiency and volleyball-specific movement effectiveness.

Table 1.
Summary of Physical Factors Influencing Vertical Jump Performance in Volleyball Athletes

No	Physical Factor	Main Findings	Statistical Evidence	Source
1	Maximum Strength	Significant positive relationship with jump height	p = 0.002 < 0.005	I. Setiawan et al. (2025)
2	Lower Limb Strength	Simultaneously influences jump performance	Contribution = 36.1%	Masrur (2025)
3	Abdominal Endurance	Supportive role in jump stability	Lower contribution	Masrur (2025)
4	Back Muscle Strength	Greater contribution than leg strength	r = 0.975 > 0.632	Pamungkas & Nidomuddin (2021)
5	Training Activity	Moderate positive relationship	r = 0.680	Kurniasandi (2022)
6	Anaerobic Capacity	Inconsistent relationship	Non-significant findings	Atik & Badilli (2024)
7	Plyometric Training	Significant improvement in jump height	Increased explosive power	Zubaidah et al. (2025)

Table 2.
Summary of Anthropometric Factors Influencing Vertical Jump Performance in Volleyball Athletes

No	Anthropometric Factor	Main Findings	Statistical Evidence	Source
1	Body Weight	Strong negative relationship with jump performance	Negative correlation	P. R. M. I. Setiawan (2025)
2	Body Mass Index (BMI)	Influences movement efficiency	Related to power-to-weight ratio	Sutralia et al. (2025)
3	Leg Length	Significant positive relationship	t = 3.62 > 1.711	Marbun (2020)
4	Arm Length	Weak relationship with jump height	Limited direct contribution	Nasuka & Priambodo (2017)
5	Body Composition	Lean body mass improves performance	Better biomechanical efficiency	Various studies

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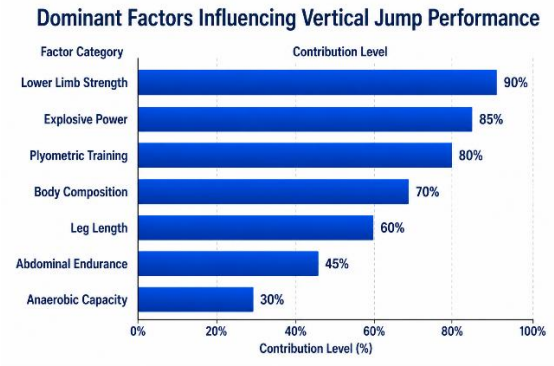

Figure 1.
Dominant Factors Influencing Vertical Jump Performance

Discussion

The findings of this literature review demonstrate that vertical jump performance in volleyball is influenced by a complex interaction between physical and anthropometric factors. Among these variables, physical factors appear to have more dominant and consistent contributions to vertical jump performance than anthropometric characteristics. This result aligns with contemporary sports science theories emphasizing that jumping performance is primarily determined by neuromuscular capacity, explosive force production, and biomechanical efficiency (Zhao et al., 2021; Ramirez-Campillo et al., 2020). Volleyball athletes require optimal vertical jump ability because spiking and blocking actions rely heavily on explosive lower-body performance to maximize attack effectiveness and defensive coverage (Giatsis & Tilp, 2022; Pawlik & Mroczek, 2023).

Physical Factors Affecting Vertical Jump

Physical Factors that Consistently Influence Vertical Jump

The present review confirms that lower limb muscle strength is one of the most consistent physical determinants influencing vertical jump performance. Physiologically, lower limb muscles such as the quadriceps, hamstrings, gluteus maximus, and gastrocnemius function as the primary force generators during explosive jumping actions (Cabarkapa et al., 2025). Stronger lower limb musculature enables athletes to produce greater ground reaction force, resulting in higher jump elevation and improved volleyball performance (Masrur, 2025). This finding is consistent with previous studies indicating that muscle strength significantly contributes to explosive athletic performance, particularly in sports requiring repeated jumping actions (Loturco et al., 2021; Suchomel et al., 2018). During vertical jump execution, explosive extension at the hip, knee, and ankle joints occurs through coordinated muscle contractions that generate upward propulsion force (Markovic & Mikulic, 2020). Consequently, athletes possessing greater muscular strength generally demonstrate superior jumping ability. Explosive power was also identified as a dominant and consistent factor affecting vertical jump performance. Explosive power represents the integration between muscular strength and contraction velocity, both of which are essential for producing maximal force within minimal time (Cormie et al., 2019). The importance of explosive power in volleyball is highly relevant because spiking and blocking movements require rapid force production under competitive conditions (Zubaidah et al., 2025).

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Previous research demonstrated that plyometric training significantly improves explosive power by enhancing stretch-shortening cycle efficiency, motor unit recruitment, and tendon stiffness adaptations (Ramirez-Campillo et al., 2020; Moran et al., 2021). Biomechanically, explosive power contributes directly to jump height because the velocity of take-off strongly influences the athlete's center of mass displacement during jumping (Samozino et al., 2018). Athletes with superior explosive power can generate greater impulse force during the propulsion phase, thereby increasing vertical displacement. This explains why plyometric exercises such as depth jumps, box jumps, and hurdle jumps consistently improve volleyball athletes' jump performance (Zubaidah et al., 2025).

Physical Factors Influencing Vertical Jump

Maximal strength was categorized as an influencing factor rather than an absolute determinant because strong muscles alone are insufficient without adequate contraction speed and neuromuscular coordination (I. Setiawan et al., 2025). This finding supports the force-velocity principle proposed in sports physiology, which states that maximal strength must be converted into explosive movement through rapid neuromuscular activation (Cormie et al., 2019). In volleyball athletes, maximal strength serves as the foundational capacity upon which explosive power development depends. Training activity was also found to positively influence vertical jump performance through neuromuscular adaptation mechanisms. Structured and progressive training improves muscle fiber recruitment, intramuscular coordination, and movement efficiency (Kurniasandi, 2022). According to Bompa and Buzzichelli (2019), long-term physical conditioning programs significantly enhance athletic performance when training specificity and overload principles are properly implemented. However, the effectiveness of training activity depends greatly on training intensity, frequency, and exercise specificity. Volleyball-specific training programs emphasizing explosive movement patterns produce greater vertical jump improvements than general conditioning exercises (Moran et al., 2021). This explains why athletes with similar training durations may exhibit different jump performances depending on program design and physiological adaptation levels.

Physical Factors that Do Not Always Influence Vertical Jump

This review also identified several physical variables that do not consistently influence vertical jump performance. Anaerobic capacity, for instance, did not always show significant relationships with jump height (Atik & Badilli, 2024). Physiologically, anaerobic energy systems are more dominant during repeated high-intensity activities rather than single explosive movements such as maximal vertical jumps (Gastin, 2017). Vertical jumping primarily relies on phosphagen energy pathways and immediate neuromuscular force production rather than prolonged anaerobic metabolism. Similarly, the role of back and core muscles demonstrated inconsistent contributions across studies (Pamungkas & Nidomuddin, 2021). Although core musculature contributes to trunk stabilization and kinetic chain coordination, its direct effect on jump height depends on movement efficiency and technical execution (Behm et al., 2021). Athletes with poor movement mechanics may fail to optimally transfer force despite possessing

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strong trunk musculature. These inconsistencies highlight the multifactorial nature of vertical jump performance. Performance outcomes are not solely determined by isolated variables but rather by integrated neuromuscular coordination, biomechanical efficiency, and sport-specific movement adaptation (Markovic & Mikulic, 2020).

Physical Factors that Do Not Influence Vertical Jump

Some forms of physical training were found to have no significant influence on vertical jump performance when they lacked specificity toward explosive movement patterns (N. Hidayat, 2023). This finding strongly supports the specificity principle in sports training theory, which states that physiological adaptations occur according to the specific demands imposed during training (Bompa & Buzzichelli, 2019). Resistance training methods emphasizing slow contraction speed or endurance-based exercises may improve general fitness without substantially enhancing explosive jumping performance. Volleyball athletes require training modalities that specifically target rapid force production, reactive strength, and neuromuscular explosiveness (Ramirez-Campillo et al., 2020). Consequently, coaches should prioritize sport-specific power development programs rather than generalized conditioning approaches.

Anthropometric Factors Affecting Vertical Jump

Anthropometric Factors that Consistently Influence Vertical Jump

Among anthropometric variables, body weight emerged as the most consistent factor influencing vertical jump performance. Excessive body mass increases the mechanical load that must be overcome during take-off, thereby reducing movement efficiency and jump height (P. R. M. I. Setiawan, 2025). Biomechanically, greater body mass increases gravitational resistance, making it more difficult for athletes to accelerate vertically (Winter, 2018). This finding aligns with previous studies reporting negative relationships between body fat percentage and explosive athletic performance (Alvero-Cruz et al., 2021; Nikolaidis et al., 2019). Athletes with excessive non-functional mass generally demonstrate lower power-to-weight ratios, limiting their ability to generate efficient vertical propulsion.

Anthropometric Factors Influencing Vertical Jump

Leg length was identified as a variable influencing vertical jump performance because it contributes to biomechanical leverage systems during jumping movements (Marbun, 2020). Longer lower extremities may increase force application distance and improve movement mechanics during take-off (Lees et al., 2021). However, longer limbs alone do not guarantee superior jump performance without adequate muscular strength and coordination. Body Mass Index (BMI) also demonstrated moderate influence on jumping ability because it represents the relationship between body mass and body height (Sutralia et al., 2025). Athletes with optimal BMI values tend to exhibit better movement efficiency and force production. Nevertheless, BMI has limitations because it cannot distinguish between fat mass and lean muscle mass (Ackland et al., 2017).

Anthropometric Factors that Do Not Always Influence Vertical Jump

The present review revealed that BMI does not consistently influence vertical jump performance across all athlete populations. This inconsistency may result from differences

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in body composition among volleyball athletes (Sutralia et al., 2025). For example, athletes with high muscle mass may present elevated BMI values while still maintaining excellent jump performance. Similarly, body circumferences and body proportions did not consistently contribute significantly to vertical jump outcomes (Irsyada, 2022). Their influence tends to be indirect through biomechanical interactions with muscle strength, coordination, and movement technique rather than acting as independent determinants.

Anthropometric Factors that Do Not Influence Vertical Jump

Arm length was found to have no direct influence on vertical jump performance because it primarily contributes to reach capability rather than force generation during take-off (Nasuka & Priambodo, 2017). In volleyball, longer arms provide advantages during spiking and blocking reach; however, they do not directly improve the athlete's ability to elevate vertically. This finding indicates that not all anthropometric characteristics should be considered primary indicators of jump performance. Vertical jump ability remains predominantly dependent on trainable neuromuscular capacities rather than static anatomical dimensions. Therefore, coaches and practitioners should focus more heavily on developing explosive strength and movement efficiency rather than relying solely on anthropometric advantages during athlete selection and performance evaluation.

Overall, this literature review confirms that vertical jump performance in volleyball is multidimensional and strongly influenced by the interaction between physical conditioning and anthropometric characteristics. Physical variables, especially lower limb strength and explosive power, demonstrate the strongest and most consistent influence, whereas anthropometric factors mainly serve as supporting biomechanical components. These findings provide important implications for volleyball training design, athlete development, and evidence-based performance optimization programs.

CONCLUSION

Based on the findings and discussion of this literature review, it can be concluded that vertical jump performance in volleyball is influenced by the interaction between physical and anthropometric factors, with physical factors demonstrating the most dominant contribution. Lower limb muscle strength and explosive power were consistently identified as the primary determinants of jump height because they directly contribute to the generation of vertical propulsive force during explosive movements. Athletes with greater neuromuscular capacity generally exhibit superior jumping performance, particularly in volleyball-specific actions such as spiking and blocking.

Other physical components, including maximal strength and training activity, also contribute to vertical jump improvement. However, their effects tend to be indirect and highly dependent on training specificity, exercise intensity, and the quality of the conditioning program applied. In contrast, variables such as anaerobic capacity and the contribution of non-primary muscles showed inconsistent findings and therefore cannot be considered universal determinants of vertical jump performance. From an

anthropometric perspective, body weight and leg length influence vertical jump ability mainly through biomechanical mechanisms related to leverage systems and movement efficiency. Nevertheless, these contributions are generally supportive rather than dominant. Other anthropometric variables such as Body Mass Index (BMI) and arm length demonstrated limited or inconsistent relationships with jump height.

Overall, vertical jump is a multidimensional performance ability resulting from the integration of neuromuscular function, anthropometric characteristics, and training adaptations. Therefore, volleyball training programs should prioritize the development of lower limb strength and explosive power through structured and sport-specific conditioning programs, supported by optimal body composition management to maximize athlete performance.

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