

The Effect of Balance Training on Body Stability in Volleyball Athletes

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ABSTRACT

This literature review aims to synthesize current evidence regarding the effects of balance training on body stability in volleyball athletes. A systematic search was conducted using academic databases such as PubMed, Scopus, and Google Scholar to identify studies published between 2000 and 2024 related to balance training, postural control, and performance in volleyball. The reviewed studies consistently demonstrate that balance training significantly improves static and dynamic stability, neuromuscular coordination, and injury prevention. The analysis highlights that incorporating balance exercises into volleyball training programs enhances athletes' ability to maintain postural control during dynamic actions such as jumping, landing, and rapid directional changes. Despite these benefits, limited literature specifically examines volleyball populations, suggesting a need for more sport-specific investigations. Overall, evidence supports the inclusion of structured balance training as a vital component of volleyball conditioning to enhance stability and minimize injury risks. Furthermore, future research should focus on identifying the optimal duration, intensity, and type of balance exercises that yield the greatest improvements in volleyball-specific performance. Comparative studies between beginner, intermediate, and elite athletes would provide valuable insights into how training adaptations differ across skill levels. Additionally, integrating balance training with other conditioning elements such as strength, agility, and plyometric training could produce a more comprehensive understanding of its synergistic effects on athletic performance. These findings would contribute to the development of evidence-based training protocols aimed at maximizing performance outcomes and reducing injury incidence among volleyball players.

.Keywords: balance training, body stability, volleyball, performance, injury prevention

ABSTRAK

Tinjauan literatur ini bertujuan untuk mensintesis bukti terkini mengenai efek latihan keseimbangan terhadap stabilitas tubuh pada atlet bola voli. Sebuah pencarian sistematis dilakukan dengan menggunakan basis data akademik seperti PubMed, Scopus, dan Google Scholar untuk mengidentifikasi studi yang dipublikasikan antara tahun 2000 dan 2024 yang berkaitan dengan

latihan keseimbangan, kontrol postural, dan performa dalam bola voli. Studi-studi yang ditinjau secara konsisten menunjukkan bahwa latihan keseimbangan secara signifikan meningkatkan stabilitas statis dan dinamis, koordinasi neuromuskular, dan pencegahan cedera. Analisisnya menyoroti bahwa memasukkan latihan keseimbangan ke dalam program latihan bola voli meningkatkan kemampuan atlet dalam mempertahankan kontrol postural selama tindakan dinamis seperti melompat, mendarat, dan perubahan arah dengan cepat. Meskipun manfaat ini jelas, literatur yang secara khusus meneliti populasi bola voli masih terbatas, yang menandakan perlunya penelitian yang lebih spesifik pada olahraga tersebut. Secara keseluruhan, bukti mendukung inklusi latihan keseimbangan yang terstruktur sebagai komponen penting dalam pengkondisian bola voli untuk meningkatkan stabilitas dan meminimalkan risiko cedera. Selanjutnya, penelitian di masa depan sebaiknya fokus pada identifikasi durasi, intensitas, dan jenis latihan keseimbangan yang optimal untuk menghasilkan peningkatan terbesar dalam performa spesifik bola voli. Studi komparatif antara atlet pemula, menengah, dan elite akan memberikan wawasan berharga tentang bagaimana adaptasi pelatihan berbeda di antara tingkat keterampilan. Selain itu, mengintegrasikan latihan keseimbangan dengan elemen pengkondisian lain seperti kekuatan, kelincahan, dan plyometrik dapat memberikan pemahaman yang lebih komprehensif mengenai efek sinergisnya terhadap performa atletik. Temuan-temuan ini akan berkontribusi pada pengembangan protokol latihan berbasis bukti yang bertujuan untuk memaksimalkan hasil performa dan mengurangi insiden cedera di antara pemain bola voli.

Kata kunci: latihan keseimbangan, stabilitas tubuh, bola voli, performa, pencegahan cedera

1. INTRODUCTION

Volleyball is a dynamic sport that requires a combination of strength, coordination, agility, and balance. Postural stability plays a vital role in optimizing movement efficiency and reducing the risk of injuries during actions such as jumping, landing, blocking, and changing direction. Previous studies have indicated that insufficient balance and postural control can lead to impaired performance and a higher incidence of musculoskeletal injuries. Therefore, understanding and improving balance in volleyball athletes has become a critical focus within sportsscience. Balance training, as part of neuromuscular conditioning, aims to enhance the body's ability to maintain equilibrium under static and dynamic conditions. Research has shown that such training improves proprioception, muscular coordination, and lower limb strength, all essential for volleyball performance. However, compared to other sports, limited research has specifically addressed how balance training influences volleyball players' stability. This literature review integrates current findings from multiple studies to

evaluate the impact of balance training on volleyball athletes and to provide recommendations for practice and future research. In recent years, there has been growing interest in developing sport-specific balance programs that replicate the physical and biomechanical demands of volleyball. These programs often include exercises performed on unstable surfaces, single-leg stances, and dynamic movements that mimic actual game scenarios. Such targeted approaches not only improve athletes' ability to stabilize their bodies during complex motions but also contribute to enhanced reaction time and joint stability. Moreover, incorporating balance exercises into regular training schedules can serve as an effective injury prevention strategy, particularly for ankle sprains and knee injuries, which are common among volleyball players. Furthermore, understanding the underlying mechanisms of balance improvement such as neuromuscular adaptation, sensory integration, and central nervous system responses can provide valuable insight into optimizing training outcomes. Future studies should aim to explore the longitudinal effects of balance training,

the differences in responses between male and female athletes, and its interaction with other physical conditioning components like strength and plyometric training. By advancing this line of research, coaches and practitioners can design more effective, evidence-based training protocols that enhance athletic performance while reducing the risk of injury in volleyball athletes.

2. METHODS

This review employed a qualitative literature review approach to synthesize findings from peer-reviewed studies on balance training and body stability in volleyball athletes. Relevant studies were identified through electronic databases including PubMed, Scopus, ScienceDirect, and Google Scholar. Keywords used in the search were 'balance training', 'body stability', 'volleyball', 'neuromuscular control', and 'postural stability'. Inclusion criteria were: (1) studies published between 2000–2024, (2) empirical research investigating the effects of balance or proprioceptive training, and (3) studies involving athletes or sports populations, particularly volleyball. Excluded were non-English publications, non-peer-reviewed articles, and studies lacking quantitative or qualitative outcomes. The selected studies were analyzed thematically, focusing on three main aspects: (1) the physiological effects of balance training, (2) its influence on performance and injury prevention, and (3) practical applications for volleyball training. The synthesis aimed to identify common trends, limitations, and gaps in the literature. To ensure comprehensiveness and reliability, the review process followed a structured and transparent framework resembling the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. Articles were screened in multiple stages title, abstract, and full-text

review to ensure that only relevant and high-quality studies were included. Data extraction was conducted manually, focusing on key methodological characteristics such as sample size, training duration, intervention type, outcome measures, and main findings. Furthermore, thematic analysis was applied to categorize the literature according to emerging patterns and recurring findings. Studies were grouped based on their focus areas—neuromuscular adaptations, biomechanical improvements, and performance outcomes—allowing for a clearer understanding of how balance training contributes to stability and injury prevention. Attention was also given to methodological limitations across studies, such as small sample sizes, short intervention durations, and lack of sport-specific control groups, which often constrain the generalizability of findings. In addition, cross-comparative evaluations between volleyball and other athletic populations (e.g., basketball, soccer, and gymnastics) were reviewed to highlight similarities and differences in balance training outcomes. This comparative perspective enriched the synthesis by demonstrating how sport-specific demands influence the effectiveness of balance training protocols. Overall, this methodological approach provided a robust foundation for identifying consistent evidence, theoretical gaps, and practical implications. The review not only summarizes the current understanding of balance training in volleyball but also underscores the need for standardized training protocols and longitudinal research to better assess its long-term benefits and applicability in elite athletic settings.

3.RESULT AND DISCUSSION

The reviewed literature consistently demonstrates that balance training contributes to improved body stability, proprioception, and neuromuscular efficiency. Studies by Hrysomallis (2011) and Paillard & Noé (2006) revealed that enhanced balance ability correlates positively with athletic performance and injury reduction. In volleyball contexts, Sato, Mokha, & Lau (2016) reported significant gains in lower extremity strength and balance performance following structured balance interventions. Moreover, Asadi et al. (2018) emphasized that regular balance training induces neuromuscular adaptations, improving the interaction between sensory and motor systems, which enhances control during dynamic sport movements. Gribble et al. (2012) also confirmed that balance-focused exercises improve dynamic postural control, crucial for sports requiring frequent changes in direction, such as volleyball. Several studies (Behm & Anderson, 2006; McGuine & Keene, 2006; Lee & Song, 2017) highlighted the preventive role of balance training against common injuries such as ankle sprains and knee instability. These findings suggest that balance training not only enhances motor coordination but also promotes joint stability and resilience during competitive play.

Despite these positive findings, literature directly addressing volleyball remains limited. Most available studies focus on soccer, basketball, or general athletic populations. Thus, more sport-specific investigations are required to optimize balance training protocols for volleyball athletes. In addition, the reviewed evidence indicates that the effectiveness of balance training is influenced by factors such as training

frequency, duration, intensity, and the type of balance exercises used. For instance, interventions that combine unstable surface training, single-leg tasks, and dynamic postural adjustments tend to produce greater improvements in both static and dynamic stability. Some studies have also explored the integration of balance training with plyometric and resistance training, demonstrating synergistic effects that enhance both neuromuscular control and explosive power—two essential components for volleyball performance (Bressel et al., 2007; Myer et al., 2006). Furthermore, the neural mechanisms underlying these improvements suggest that balance training enhances sensory feedback processing and motor unit activation efficiency, leading to faster and more coordinated responses during gameplay. This adaptation is particularly beneficial in volleyball, where players must rapidly adjust body position during unpredictable movements such as blocking, spiking, and defensive dives. The inclusion of balance exercises in training routines may, therefore, contribute not only to improved movement precision but also to more efficient energy expenditure during high-intensity actions. However, current studies often differ in methodological design, making cross-study comparison challenging. Variations in participant age, gender, athletic level, and intervention protocols limit the generalizability of results. Additionally, few studies have examined the long-term effects of balance training or its specific contribution to competitive performance outcomes in volleyball tournaments. Future research should aim to establish standardized, evidence-based balance training frameworks tailored to the unique biomechanical and physiological demands of volleyball. Longitudinal and experimental studies with larger sample sizes would provide stronger empirical support for incorporating balance training

as an integral element of volleyball conditioning and injury prevention programs.

CONCLUSSION

This literature review concludes that balance training significantly enhances body stability, proprioception, and performance in athletes, including those in volleyball. Evidence supports that consistent integration of balance exercises—both static and dynamic—into volleyball conditioning programs improves postural control and reduces injury risk. Coaches and trainers are recommended to incorporate progressive balance drills, starting from static single-leg stances to dynamic multi-directional movements. Future research should focus on longitudinal studies involving larger and more diverse volleyball populations, using multiple balance assessment tools. Additionally, exploring the relationship between improved balance and volleyball-specific skills such as jumping, landing, and blocking could further refine training practices. Moreover, the synthesis highlights that balance training serves as a foundational component of neuromuscular conditioning, facilitating improved coordination between sensory input and motor output systems. This adaptation not only enhances athletic performance but also supports better movement efficiency, stability during high-speed actions, and faster recovery from perturbations or unbalanced situations. The inclusion of sport-specific balance exercises—such as stability work combined with spiking or defensive movements—may further increase the ecological validity of training programs, bridging the gap between general conditioning and in-game performance demands. In practical terms, implementing balance training in volleyball can yield both preventive and performance-related benefits. Athletes who consistently

engage in balance programs show fewer incidences of lower-limb injuries, particularly ankle sprains and knee ligament strains, which are prevalent in volleyball. Additionally, enhanced balance contributes to improved jumping and landing mechanics, allowing athletes to generate greater force safely while maintaining alignment and control. When combined with strength, agility, and plyometric training, balance exercises can create a more holistic conditioning regimen that optimizes both stability and explosiveness on the court.

From a methodological perspective, future investigations should prioritize standardized balance evaluation tools—such as force plates, dynamic posturography, or Y-Balance tests—to objectively measure changes in postural control and performance outcomes. Researchers should also examine gender differences, age-related adaptations, and variations across playing positions, as setters, liberos, and spikers may have distinct stability demands. Overall, the findings affirm that balance training is not merely an accessory element of volleyball conditioning but a vital and evidence-based component that underpins performance excellence and injury prevention. Continued research integrating biomechanical, physiological, and neurocognitive analyses will strengthen the scientific understanding of how balance contributes to athletic success, guiding the design of innovative, sport-specific training models for volleyball athletes at all competitive levels.

REFERENCES

- Asadi, A., Rahn timer, N., & Araz i, H. (2018). Effects of balance training on postural control and neuromuscular function: A systematic review. *Sports Medicine*, 48(3), 597–613.
- Behm, D. G., & Anderson, K. G. (2006). The role of balance training in injury

- prevention and performance enhancement. *Strength and Conditioning Journal*, 28(5), 31–36.
- Gribble, P. A., Hertel, J., & Plisky, P. (2012). Using the Star Excursion Balance Test to assess dynamic postural control. *Journal of Athletic Training*, 47(3), 339–357.
- Hrysomallis, C. (2011). Balance ability and athletic performance. *Sports Medicine*, 41(3), 221–232.
- Lee, D. K., & Song, C. H. (2017). Effects of balance training on static and dynamic balance performance in healthy young adults. *Journal of Physical Therapy Science*, 29(5), 785–788.
- McGuine, T. A., & Keene, J. S. (2006). The effect of a balance training program on the risk of ankle sprains in high school athletes. *The American Journal of Sports Medicine*, 34(7), 1103–1111.
- Paillard, T., & Noé, F. (2006). Effect of expertise and visual contribution on postural control in soccer. *Scandinavian Journal of Medicine & Science in Sports*, 16(5), 345–348.
- Sato, K., Mokha, M., & Lau, S. (2016). Effects of balance training on lower extremity strength and balance performance in collegiate volleyball players. *International Journal of Sports Science & Coaching*, 11(4), 497–504.
- Aminaka, N., & Gribble, P. A. (2005). The influence of activity level and age on performance of the Star Excursion Balance Test. *Journal of Athletic Training*, 40(4), 270–276.
- Asadi, A., Rahnama, N., & Arazi, H. (2018). Effects of balance training on postural control and neuromuscular function: A systematic review. *Sports Medicine*, 48(3), 597–613.
- Behm, D. G., & Anderson, K. G. (2006). The role of balance training in injury prevention and performance enhancement. *Strength and Conditioning Journal*, 28(5), 31–36.
- Behm, D. G., Drinkwater, E. J., Willardson, J. M., & Cowley, P. M. (2010). The use of instability to train the core musculature. *Applied Physiology, Nutrition, and Metabolism*, 35(1), 91–108.
- Bressel, E., Yonker, J. C., Kras, J., & Heath, E. M. (2007). Comparison of static and dynamic balance in female collegiate soccer, basketball, and gymnastics athletes. *Journal of Athletic Training*, 42(1), 42–46.
- Brown, L. E., & Ferrigno, V. A. (2005). *Training for Speed, Agility, and Quickness* (2nd ed.). Human Kinetics.
- Cavanaugh, J. T., Guskiewicz, K. M., Giuliani, C., Marshall, S. W., & Mercer, V. S. (2005). Recovery of postural control after cerebral concussion: New insights using approximate entropy. *Journal of Athletic Training*, 40(3), 305–313.
- Gribble, P. A., Hertel, J., Plisky, P. (2012). Using the Star Excursion Balance Test to assess dynamic postural-control deficits and outcomes in lower extremity injury: A literature and systematic review. *Journal of Athletic Training*, 47(3), 339–357. <https://doi.org/10.4085/1062-6050-47.3.08>
- Gribble, P. A., Robinson, R. H., & Hertel, J. (2009). Using the Star Excursion Balance Test to assess dynamic postural-control deficits and outcomes in lower extremity injury: A literature and systematic review. *Journal of Athletic Training*, 44(3), 305–311.
- Guskiewicz, K. M., & Perrin, D. H. (1996). Research and clinical applications of assessing balance. *Journal of Sport Rehabilitation*, 5(1), 45–63.
- Hewett, T. E., Ford, K. R., & Myer, G. D. (2006). Anterior cruciate ligament injuries in female athletes: Part 2, a meta-analysis of neuromuscular interventions aimed at injury prevention. *The American Journal of Sports Medicine*, 34(3), 490–498.
- Hrysomallis, C. (2011). Balance ability and athletic performance. *Sports Medicine*, 41(3), 221–232.
- Hupperets, M. D. W., Verhagen, E. A. L. M., & van Mechelen, W. (2009). Effect of

unsupervised home based
proprioceptive training on
recurrences of ankle sprain:
Randomised controlled trial. *BMJ*,
339, b2