

Article

Effects of Different Frequency Vibration Training on Lower Extremity Explosive Power of Amateur Football Players

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Abstract: This study investigated the effects of different vibration frequencies on lower limb explosive power in amateur football players. Over an 8-week experimental period, 24 amateur football players were randomly assigned to a high-frequency group (45Hz) or a low-frequency group (10Hz), with 12 participants in each group, to undergo specialized strength training on a vibration platform. Peak torque of hip and knee flexor-extension muscles and the squat jump (CMJ) height were measured before and after training to evaluate the efficacy of vibration training. The results demonstrated that high-frequency vibration training significantly enhanced lower limb strength and explosive power in the athletes. Specifically, the high-frequency group showed a 15.8% increase in peak torque of hip extensors and a 12.5% increase in CMJ height, compared to only 7.2% and 4.3% in the low-frequency group, respectively. Correlation analysis also revealed a significant positive correlation between strength gains in hip flexor-extension muscles and explosive performance. These findings suggest that the 45Hz high-frequency vibration training protocol is superior to low-frequency training in enhancing lower limb explosive power in amateur football players, providing important guidance for developing more effective strength training programs.

Keywords: Isokinetic; Vibration training; Amateur; Soccer player; Lower limb explosive power

1. Introduction

As an emerging neuromuscular training method, vibration training has garnered significant attention in sports science in recent years. This approach utilizes mechanical vibrations to stimulate the human body, triggering muscle stretch reflexes that activate more motor units, thereby enhancing muscle strength, explosive power, and coordination. The effectiveness of vibration training is primarily influenced by parameters such as vibration frequency and amplitude, with frequency being recognized as one of the key determinants of training outcomes [1,2].

In competitive sports, lower limb explosive power is a critical factor in determining athletic performance. For football players, this power directly impacts the execution of technical maneuvers such as acceleration, directional changes, dribbling, and heading. However, current research on vibration training primarily focuses on professional athletes, with relatively insufficient attention paid to amateur players. Given the differences in training conditions and recovery capabilities between amateur and professional footballers, specialized vibration training programs tailored for this group require dedicated research [3].

Current research demonstrates that vibration training at different frequencies exerts distinct effects on lower limb explosive power. In terms of acute effects, studies indicate that 40-45Hz vibrations can instantly enhance athletes' explosive performance during warm-up activities. Regarding long-term training effects, comparative studies between different vibration frequencies reveal that 45Hz high-frequency vibrations significantly

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improve lower limb muscle strength and vertical jump performance more effectively than 10Hz low-frequency vibrations. These findings suggest that vibration frequency selection plays a crucial role in determining training outcomes.

However, existing research has certain limitations. Firstly, the subject limitations make it difficult to directly generalize the conclusions to amateur athletes. Secondly, most studies adopt single-frequency training without cross-comparison of different frequency effects. Thirdly, the evaluation metrics for lower limb explosive power remain overly simplistic, primarily focusing on vertical jump height while lacking comprehensive assessment of dynamic indicators such as force generation rate [4-6].

Building upon existing research, this study investigates the effects of 10Hz and 45Hz vibration training at 8-week fixed-amplitude intervals on lower limb explosive power in amateur football players. Using rate strength testing and squat jump performance as evaluation metrics, we systematically analyze the differences in training outcomes between the two vibration frequencies. The findings aim to provide scientific evidence and practical guidance for specialized strength training programs in amateur football athletes [7].

2. Subjects and Methods

2.1. Study Subjects

Table 1 presents baseline characteristics of the study subjects, including age, height, weight, and training duration, with participants divided into a high-frequency group (45Hz) and a low-frequency group (10Hz). Analysis of these variables ensures baseline characteristic balance between the two groups, thereby minimizing the impact of confounding factors on experimental outcomes. The high-frequency group had an average age of 21.3 ± 2.1 years, height of 175.6 ± 4.2 cm, weight of 68.5 ± 5.2 kg, and training duration of 3.5 ± 1.2 years. The low-frequency group had an average age of 22.1 ± 1.8 years, height of 176.2 ± 3.9 cm, weight of 69.8 ± 4.7 kg, and training duration of 3.8 ± 1.5 years. No significant differences were observed between the two groups in any of the variables ($P \geq 0.05$), indicating comparability in baseline characteristics. These data support the scientific validity and rationality of the experimental design, providing a solid foundation for subsequent evaluation of training intervention effects. Maintaining balance in group characteristics is crucial for ensuring the validity of results and constitutes an essential component of comparative experimental designs in sports science research.

Table 1. Overview of Study Subjects.

Group	Group Age (years)	Stature (cm)	Weight (kg)	Training duration (years)	<i>p</i>
High-frequency group (45Hz)	21.3 ± 2.1	175.6 ± 4.2	68.5 ± 5.2	3.5 ± 1.2	≥ 0.05
Low-frequency group (10Hz)	22.1 ± 1.8	176.2 ± 3.9	69.8 ± 4.7	3.8 ± 1.5	≥ 0.05

Intra-group difference $P < 0.05$.

2.2. Research Methods

2.2.1. Experimental Instruments

Vibration training was conducted using the Power Plate7 vibration training system (American-made). Peak torque at the hip, knee, and ankle joints under various training conditions was measured using an isokinetic dynamometer (ISOMED 2000, D&R Ferstl GmbH, Hemau, Germany). The explosive lower limb strength was assessed through the squat-based standing vertical jump (CMJ) test, utilizing the vertical jump tester in the National Physical Fitness Monitoring System.

2.2.2. Training and Testing Scheme

All participants underwent an 8-week training program, with sessions scheduled twice weekly for 60 minutes each. The training regimen focused on football-specific strength exercises, structured into three phases: 1) Initial phase (not applicable to vibration platforms; general warm-up): jogging, dynamic stretching, and neuromuscular activation; 2) Secondary phase (conducted on vibration platforms): weighted squats, dynamic split squats, plantar-heel vibration, and rapid eccentric movements with heart rate jumps; 3) Tertiary phase (not applicable to vibration platforms; cool-down activities): low-intensity aerobic exercises and static stretching of major muscle groups.

The high-frequency group trained at a vibration frequency of 45Hz, while the low-frequency group trained at 10Hz. Both groups maintained a uniform vibration amplitude of 4mm and identical load intensity. During vibration training, participants stood with feet shoulder-width apart at the center of the training platform, heels slightly raised, and knees at a 150° angle. They could use handrails for balance support but did not rely on them. Each exercise set consisted of 3-5 repetitions, with 1-3 minutes of rest between sets. Participants maintained a training interval of at least 24 hours.

2.2.3. Test Indicators

The detailed description of the isokinetic muscle strength test and CMJ test is presented in Table 2.

Table 2. Description of Isokinetic Muscle Strength Test and CMJ Test.

Test type	Test method	Measurement indicators
Isokinetic muscle strength	Repeat the test 3 times at a speed of 300°/s, and take the maximum value to measure the peak torque of the flexion and extension muscle groups of the sacroiliac joint.	Peak torque (N·m)
CMJ	The athlete performs a squat jump with hands on hips, and the optimal height is recorded.	Jump height (cm)

Methodology Description: 1. Isokinetic Muscle Strength Test: This evaluates the maximum force output of knee flexion-extension muscles under dynamic conditions. High-precision isokinetic dynamometers ensure standardized data acquisition. Participants must exert full effort to obtain accurate measurements. 2. Vertical Jump (CMJ) Test: A gold-standard assessment of lower limb explosive power. During the test, participants maintain hands on hips to eliminate upper limb interference, focusing solely on lower limb muscle contribution. The optimal jump height across multiple attempts is recorded to ensure reliability. These standardized protocols guarantee data reproducibility and result validity, providing a robust foundation for subsequent analysis.

2.2.4. Mathematical Statistics

This study employed SPSS 27.0, a professional statistical software, to conduct an in-depth analysis of the collected data. To accurately compare the differences in explosive power test indicators between the two groups of athletes, we utilized two statistical methods: the independent samples t-test and the paired samples t-test. Additionally, a significance level of $P < 0.05$ was set to ensure that the observed differences were statistically significant.

3. Results

3.1. Changes in Peak Torque of Hip Flexion and Extension Muscle Groups

Table 3 illustrates the changes in peak torque values of the hip flexor and extensor muscle groups before and after training. In the study, subjects were divided into a high-

frequency group and a low-frequency group to evaluate the training effects on flexors and extensors, respectively. The results showed significant differences in peak torque values between the two groups for both flexors and extensors. For the extensor group, the high-frequency training group increased from 335.4±48.3 N·m before the experiment to 388.5±45.6 N·m after the experiment, with an increase of 53.1±20.5 N·m, representing a growth rate of 15.8%. The low-frequency training group increased from 338.2±47.1 N·m to 362.5±44.2 N·m, with an increase of 24.3±16.7 N·m, yielding a growth rate of 7.2%. This indicates that the high-frequency training group demonstrated significantly better results in increasing peak torque values compared to the low-frequency group. For the flexor group, the high-frequency training group increased from 135.2±21.4 N·m to 158.7±22.8 N·m, with an increase of 23.5±15.3 N·m, representing a growth rate of 17.4%. The low-frequency training group increased from 136.8±19.7 N·m to 148.3±20.5 N·m, with an increase of only 11.5±8.2 N·m, yielding a growth rate of 8.4%. The data suggest that the high-frequency training group also exhibited more significant improvements in flexor strength. In statistical analysis, significant intra-group differences ($P<0.05$) and significant inter-group differences ($P<0.01$) confirmed the effects of different training frequencies on muscle strength enhancement. These results support that high-frequency training can more effectively increase the peak torque of hip flexor and extensor muscles, which is helpful to optimize the training program to improve sports performance.

Table 3. Changes in peak torque of hip flexion and extension muscle groups before and after training (N·m).

Muscle group	Group	Pretest	Posttest	Change (N·m)	% Change
Hip extensors	High-frequency	335.4 ± 48.3	388.5 ± 45.6	53.1±20.5##	15.8
	Low-frequency	338.2 ± 47.1	362.5 ± 44.2	24.3±16.7	7.2
Hip flexors	High-frequency	135.2 ± 21.4	158.7 ± 22.8*	23.5±15.3##	17.4
	Low-frequency	136.8 ± 19.7	148.3 ± 20.5*	11.5±8.2	8.4

* $P < 0.05$ vs. Pretest (within group); ## $P < 0.01$ vs. Low-frequency group (between groups).

3.2. Changes in peak torque of knee flexion and extension muscle groups

Table 4 details the changes in peak torque values of the knee flexor and extensor muscle groups before and after training. Subjects were divided into high-frequency and low-frequency groups to evaluate the effects of different training frequencies on flexors and extensors. The results demonstrated statistically significant changes in peak torque values induced by different training protocols. In the extensor group, subjects in the high-frequency group increased from 170.3±23.1 N·m before the experiment to 203.6±20.8 N·m after the experiment, with an increase of 33.3±12.7 N·m (19.5%). In contrast, the low-frequency group increased from 169.8±24.5 N·m to 186.5±25.3 N·m, with an increase of 16.7 ± 10.2 N·m (9.8%). High-frequency training resulted in greater increases in peak torque values compared with low-frequency training. In the flexor group, subjects in the high-frequency group increased from 112.6±17.8 N·m to 132.4±18.9 N·m, with an increase of 19.8±10.5 N·m (17.6%). Meanwhile, the low-frequency group increased from 114.3±19.2 N·m to 123.1±21.4 N·m, with an increase of 8.8±7.1 N·m (7.7%). The results indicate that high-frequency training was more effective in improving flexor strength. All data showed significant intra-group differences ($*P<0.05$) and inter-group differences ($##P<0.01$), emphasizing the importance of training frequency in enhancing peak torque values of the knee muscles. The superiority of high-frequency training protocols provides significant guidance for developing training plans to improve knee muscle strength.

Table 4. Changes in peak torque of knee flexion and extension muscle groups before and after training (N·m).

Muscle group	Group	Pretest	Posttest	Change (N·m)	% Change
Knee extensors	High-frequency	170.3 ± 23.1	203.6 ± 20.8	33.3 ± 12.7##	19.5
	Low-frequency	169.8 ± 24.5	186.5 ± 25.3	16.7 ± 10.2	9.8
Knee flexors	High-frequency	112.6 ± 17.8	132.4 ± 18.9*	19.8 ± 10.5##	17.6
	Low-frequency	114.3 ± 19.2	123.1 ± 21.4*	8.8 ± 7.1	7.7

* $P < 0.05$ vs. Pretest (within group); ## $P < 0.01$ vs. Low-frequency group (between groups).

3.3. Changes in CMJ

Table 5 presents data on the change in squat jump (CMJ) height before and after training to analyze the effects of different training frequencies. Participants were divided into a high-frequency group and a low-frequency group. The high-frequency group had a mean CMJ height of 35.2±2.7 cm before training, which increased to 39.6±2.4 cm after training, with a gain of 4.4±1.0 cm (12.5%). In contrast, the low-frequency group increased from 35.8±2.5 cm to 37.3±2.1 cm, with a gain of 1.5±0.7 cm (4.3%). Statistical analysis showed significant within-group differences ($*P < 0.05$) and significant between-group differences (## $P < 0.01$). These results indicate that high-frequency training resulted in greater improvements in CMJ height compared with low-frequency training.

Table 5. Changes in squat jump (CMJ) height before and after training (cm).

Group	Pretest	Posttest	Change (cm)	% Change
High-frequency	35.2 ± 2.7	39.6 ± 2.4	4.4 ± 1.0##	12.5
Low-frequency	35.8 ± 2.5	37.3 ± 2.1	1.5 ± 0.7	4.3

* $P < 0.05$ vs. Pretest (within group); ## $P < 0.01$ vs. Low-frequency group (between groups).

3.4. Correlation Analysis Between Isokinetic Muscle Strength and CMJ

Table 6 presents the Pearson correlation analysis between the increase in peak torque of extensor and flexor muscles and the increase in CMJ height. This analysis reveals a significant linear relationship among the variables, which is crucial for understanding the correlation between muscle training effects and athletic performance. The results show a correlation coefficient of 0.75 between the increase in extensor and flexor muscle strength, indicating a significant positive correlation, suggesting that the training effects on extensor and flexor muscles are consistent. Additionally, the correlation coefficients between the increase in extensor muscle strength and the increase in CMJ height are 0.68, and between the increase in flexor muscle strength and the increase in CMJ height are 0.60, both indicating significant positive correlations ($P < 0.05$). These data emphasize that enhancing muscle strength may directly contribute to improving squat jump performance. The comprehensive analysis indicates that as extensor and flexor muscle strength increases, athletes exhibit enhanced squat jump performance. This relationship supports the importance of strength training in improving athletic performance and provides a basis for designing more effective training programs.

Table 6. Pearson correlation analysis of changes in muscle strength and CMJ height.

Variable	Extensor strength change	Flexor strength change	CMJ height change
Extensor strength change	1	0.75*	0.68*
Flexor strength change	0.75*	1	0.60*
CMJ height change	0.68*	0.60*	1

*Correlation is significant at $P < 0.05$.

4. Discussion

This study investigated the effects of vibration training at different frequencies on lower limb explosive power in amateur football players. The results demonstrated that high-frequency training (45Hz) exhibited more significant improvements in muscle strength and explosive power [8,9]. This difference can be discussed from multiple perspectives, including neuromuscular system adaptation, mechanical effects of vibration training, and specific athletic demands. Firstly, regarding neuromuscular system adaptation, the core of vibration training lies in triggering stretch reflexes through mechanical vibration stimulation, thereby activating more muscle motor units. High-frequency vibration training provides faster vibration stimulation frequencies, enhancing both the intensity and amplitude of stimulation, which recruits more motor units [10,11]. This aligns with existing literature, indicating that high-frequency vibration effectively promotes neuromuscular recruitment and synchronization, thereby improving muscle strength and explosive power. Secondly, from the perspective of mechanical effects, vibration training enhances muscle strength through effective force stimulation. The greater acceleration induced by high-frequency vibration leads to more frequent and intense mechanical stimulation of muscle fibers, rapidly increasing intramuscular tension and strength [12]. This enhanced muscle responsiveness plays a critical role in improving athletes' explosive power. Additionally, considering the specific athletic demands of football, which relies on rapid lower limb explosive power for executing technical movements such as starts, shots, and changes of direction, 45Hz vibration better simulates these demands [13-15]. This may be attributed to the more pronounced activation and strengthening of fast-twitch muscle fibers under higher-frequency vibration training, providing athletes with more targeted muscle adaptation. While high-frequency training demonstrates significant advantages, the relatively weaker effects of low-frequency training may be attributed to insufficient stimulation. In this study, the 10Hz vibration frequency might not have adequately stimulated the neuromuscular system to optimal stress levels, resulting in insufficient activation and recruitment of motor units [16]. For amateur athletes with relatively high neural plasticity, high-frequency vibrations could trigger more pronounced muscular adaptations. Notably, this study has certain limitations in sample size, training cycles, and vibration parameter design. Therefore, future research should expand sample sizes to better validate the generalizability of findings and their practical application potential in training. Additionally, optimizing vibration training parameters, exploring optimal frequency-amplitude combinations, and further enhancing athletic performance in amateur athletes remain key focuses for future studies [17-19]. In summary, this study demonstrates that 45Hz high-frequency vibration training exhibits more significant effects in improving lower limb explosive power in amateur soccer players. This finding provides a new perspective for specialized strength training in amateur soccer, suggesting increased use of high-frequency vibration protocols in training plans to maximize athletes' explosive power and competitive performance [20-22].

5. Conclusion

This study systematically analyzed the effects of vibration training at different frequencies on lower limb explosive power in amateur football players over an 8-week period. The results demonstrated a significant superiority of high-frequency vibration training at 45Hz compared to low-frequency vibration training at 10Hz. The main conclusions of this study are as follows:

The significant effects of high-frequency vibration training: The high-frequency group demonstrated more pronounced improvements in peak torque of hip and knee flexion-extension muscle groups, as well as in the squat jump (CMJ) height. This indicates

that high-frequency vibration can more effectively activate the neuromuscular system and enhance muscle explosive power.

Limitations of low-frequency vibration training: In comparison, although the low-frequency group also demonstrated some degree of improvement, the magnitude was significantly less than that of the high-frequency group. This may be attributed to the insufficient neural-muscular adaptation induced by low-frequency vibration, thereby limiting the enhancement of athletic performance.

Meeting specific athletic demands: In football, explosive power is crucial for the execution of technical movements. High-frequency vibrations can provide a more effective muscle activation method in specialized strength training, thereby fulfilling the actual athletic requirements of athletes.

Practical Value and Application Prospects: This study provides scientific evidence for amateur football players to incorporate high-frequency vibration training into their regimens, optimizing strength-building methods to maximize explosive power and competitive performance. In conclusion, selecting appropriate vibration training parameters is crucial for enhancing amateur football players' athletic performance. Future research should further explore combinations of vibration frequencies and training intensities to refine training protocols, thereby improving their effectiveness and applicability.

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References

1. E. J. Santos, and M. A. Janeira, "Effects of reduced training and detraining on upper and lower body explosive strength in adolescent male basketball players," *The Journal of Strength & Conditioning Research*, vol. 23, no. 6, pp. 1737-1744, 2009. doi: 10.1519/jsc.0b013e3181b3dc9d.
2. G. Litao, Y. Jintian, and L. Xutao, "Influence of lower limb resistance training on the explosive quality of athletes," *Revista Brasileira de Medicina do Esporte*, vol. 29, p. e2023_0015, 2023. doi: 10.1590/1517-8692202329012023_0015.
3. D. Ivanov, "Assessment of lower limb asymmetry in elite U16 football players using jump tests and kineo technology," *Sport Mont*, vol. 23, no. 3, pp. 33-40, 2025. doi: 10.26773/smj.251005.
4. B. Wu, M. Yin, Z. Song, M. Tao, K. Xu, G. P. Nassis, and O. Girard, "Effects of unilateral and bilateral training on performance in team sports athletes: a systematic review and meta-analysis," *Biology of Sport*, vol. 37, pp. 1-15, 2020. doi: 10.17605/OSF.IO/S8CMA.
5. J. Wang, Z. Zeng, Q. Lu, S. Yuan, and Y. Chai, "Comparative study of the effects of VBT training with different velocity loss thresholds on lower limb explosive force of adolescent sprinters," *Frontiers in Physiology*, vol. 16, p. 1746516, 2026. doi: 10.3389/fphys.2025.1746516.
6. X. Wang, X.-M. Qin, S. Ji, and D. Dong, "Effects of resistance training with blood flow restriction on explosive power of lower limbs: A systematic review and meta-analysis," *Journal of Human Kinetics*, vol. 89, pp. 259-268, 2023, doi: 10.5114/jhk.168308.
7. S. Sharma and Z. Hayat, "Effects of whole-body vibration on sports performance: A systematic review and meta-analysis," *Science & Sports*, vol. 37, no. 4, pp. 231-243, 2022. doi: 10.1016/j.scispo.2021.06.015.
8. R. Huang, M. Zhang, L. Huang, Z. Chen, Y. Mo, and Y. Gao, "Effects of lower-extremity explosive strength on youth judo athletes adopting different types of power-based resistance training," *Frontiers in Physiology*, vol. 14, p. 1065036, 2023. doi: 10.3389/fphys.2023.1065036.
9. R. Hu, M. Zhao, X. Shen, and Z. Wang, "The effects of an 8-week complex training program on lower limb explosive power and movement agility in adolescent female badminton players," *Frontiers in Physiology*, vol. 16, p. 1678866, 2025. doi: 10.3389/fphys.2025.1678866.
10. B. Fan, "The Influence of Compound Training on the Explosive Power of Basketball Players' Lower Limbs," in *HBDSS 2022; 2nd International Conference on Health Big Data and Smart Sports*, Oct. 2022, pp. 1-7, VDE.
11. M. Cossio-Bolaños, R. Vidal-Espinoza, C. U. Albornoz, D. L. Portella, S. Vega-Novoa, J. Mendez-Cornejo, and R. Gomez-Campos, "A systematic review of intervention programs that produced changes in speed and explosive strength in youth footballers," *European Journal of Translational Myology*, vol. 31, no. 3, p. 9692, 2021. doi: 10.4081/ejtm.2021.9692.
12. Z. Wang, Z. Wei, X. Li, Z. Lai, and L. Wang, "Effect of whole-body vibration on neuromuscular activation and explosive power of lower limb: A systematic review and meta-analysis," *PLoS One*, vol. 17, no. 12, e0278637, 2022. doi: 10.1371/journal.pone.0278637.

13. Q. Wang, Y. Zhu, Y. Li, and X. Wang, "Application of Rapid Telescopic Compound Training Method in Athletes' Explosive Training," *Frontiers in Sport Research*, vol. 7, no. 5, 2025. doi: 10.25236/FSR.2025.070501.
14. Z. Liu and W. Zeng, "A comparative study of compression training and conventional resistance training in the development of lower limb explosive power in adolescent track and field athletes," *Global Sport Science*, vol. 1, no. 1, p. 64, 2023. doi: 10.58195/gss.v1i1.50.
15. F. L. Pinto, H. P. Neiva, M. C. Marques, D. A. Marinho, L. Branquinho, and R. Ferraz, "Utilizing contextualized skills and coach intervention to optimize the performance of ultimate full-contact fighters," *Ido Movement for Culture. Journal of Martial Arts Anthropology*, vol. 22, no. 4, 2022. doi: 10.14589/ido.22.4.4.
16. M. Li, Y. Zhu, and Y. Peng, "The Relationship Between Lower-Limb Explosive Strength and Climbing Speed in Elite Speed Climbers: A Comprehensive Analysis Based on Muscle Morphology and Electromyography," *International Journal of Sports Physiology and Performance*, vol. 1, no. aop, pp. 1-7, 2026. doi: 10.1123/ijsp.2025-0329.
17. R. Cloak, A. Nevill, and M. Wyon, "The acute effects of vibration training on balance and stability amongst soccer players," *European journal of sport science*, vol. 16, no. 1, pp. 20-26, 2016. doi: 10.1080/17461391.2014.973912.
18. C. Tang, "Effects of vibration strength training on lower limb joints in long jumpers," *Revista Brasileira de Medicina do Esporte*, vol. 29, p. e2022_0320, 2022. doi: 10.1590/1517-8692202329012022_0320.
19. F. A. Adegoju, and J. K. Abon, "EFFECT OF WHOLE BODY VIBRATION TRAINING ON SELECTED HEALTH RELATED COMPONENTS AMONG AMATEUR PLAYERS IN THE POLYTECHNIC, IBADAN FOOTBALL TEAM, IBADAN, NIGERIA," *European Journal of Fitness, Nutrition and Sport Medicine Studies*, vol. 1, no. 2, 2020. doi: 10.46827/ejfnsm.v1i2.83.
20. T. Despina, D. George, T. George, P. Sotiris, D. C. Alessandra, K. George, and K. Stavros, "Short-term effect of whole-body vibration training on balance, flexibility and lower limb explosive strength in elite rhythmic gymnasts," *Human movement science*, vol. 33, pp. 149-158, 2014. doi: 10.1016/j.humov.2013.07.023.
21. P. Fischerova, M. Nitychoruk, W. Smolka, M. Zak, A. Golas, and A. Maszczyk, "The impact of strength training on the improvement of jumping ability and selected power parameters of the lower limbs in soccer players," *Baltic Journal of Health and Physical Activity*, vol. 13, no. 1, p. 9, 2021. doi: 10.29359/BJHPA.13.1.09.
22. J. Arede, J. Wells, M. Williams, F. Garcia, and W. Schöllhorn, "Evaluating Differential Basic Resistive Skills Training Effects on Sprint, Jump, and Agility in Young Basketball Athletes," *Journal of Functional Morphology and Kinesiology*, vol. 10, no. 3, p. 323, 2025. doi: 10.3390/jfmk10030323.

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