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Research Protocol

Physiotherapy Section

Effect of Combined Plyometrics and Balance Training versus Eccentric Resistance Training with Conventional Physiotherapy for Functional Ankle Instability in Badminton Players: A Research Protocol

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ABSTRACT

Introduction: As a racquet sport, badminton demands a wide range of skilled postural adjustments and movements, including jumps, lunges, rapid change of direction and quick arm movement. Acute lateral ankle sprain is a common injury among athletes. Lateral ankle sprains can cause motor behaviour disorders. Repeated ankle sprains can lead to ankle instability, which can repeatedly disrupt performance.

Need of the study: The existing research has largely investigated plyometric and balance training in isolation. There is limited evidence examining the combined effect of plyometric and balance training integrated with strength, power, or endurance components. Moreover, many studies have not consistently incorporated clinically relevant outcome measures to guide rehabilitation progression. Therefore, a clear knowledge gap exists regarding the effectiveness of a comprehensive, multi-component rehabilitation program in optimising functional recovery and preventing recurrence in badminton athletes with Functional Ankle Instability (FAI).

Aim: The present study aims to evaluate the effect of plyometric and balance training versus eccentric resistance training in addition to conventional physiotherapy for FAI in badminton athletes.

Materials and Methods: The present three-arm parallel randomised controlled trial will be conducted at 1) Sports OPD, Ravi Nair Physiotherapy College, Sawangi, Wardha, Maharashtra, India, 2) District badminton court Wardha, Maharashtra, India, from July 2025 to June 2026. Participants will be allocated to a 6-week combined plyometric and balance training versus eccentric resistance in addition to a conventional program. Training will be performed three times per week. Outcome measures assessed will be the Sargent jump, 15 m Sprint and Y-Shaped agility. Between-group comparisons across the three arms will be performed using One-way Analysis of Variance (ANOVA) for normally distributed data or the Kruskal-Wallis test for non normal data. Post-hoc tests (Bonferroni/Tukey for ANOVA or Dunn's test for Kruskal-Wallis) will be applied to identify differences between specific groups. Within-group pre and post-intervention changes will be assessed using paired t-tests (normal data) or Wilcoxon signed-rank tests (non normal data). A p-value of <0.05 will be considered statistically significant.

Keywords: Explosive strength, Rehabilitation, Sprint, Y-Agility

INTRODUCTION

Badminton is an indoor game that is played internationally. It comprises jumping actions. It has two aims, i.e., achieving the highest height and reaching a particular location, using body actions [1]. Dynamic joint stabilisation occurs through the contraction of the muscles that surround the joint. The actions, such as running, chopping, and jumping, require the athlete to use muscle contraction and eccentric control to reduce forces between the surface and ankle complex [1]. Badminton involves a wide range of postural changes and different, swift arm movements [2]. Effective movement on the badminton court that assists in reaching the shuttlecock in the least number of steps while maintaining good balance [2]. To perform well and avoid injuries, badminton players typically require a high degree of dynamic balance for sudden movement throughout the court [3].

The ability of the body to keep its base of support with minimal movement when standing, i.e., dynamic balance, refers to balance and dynamic balance includes some degree of anticipated movements surrounding the Centre Of Gravity (COG) projection [3]. A lateral ankle sprain, which is acute, is an injury often experienced by players who play in field, court, and indoor sports [4]. Lateral ankle sprain may lead to the emergence of a range of motor-behavioural impairments, including changes in lower limb stiffness, variability in lower limb joint coupling, and suppression of ankle invertor and ankle evertor strength. In the long term, lateral ankle sprains can cause Chronic Ankle Instability (CAI), osteoarthritis, persistent disability, impaired quality of life and reduction in self-reported ankle joint function [4].

Ankle sprains, which occur frequently, are a sign of CAI. It most commonly can happen while walking or performing other activities, but may also develop while standing. Most of the athletes suffer from CAI. The peroneus longus muscle and the tibialis anterior play crucial roles in maintaining ankle stability while walking, running, and landing [4].

Patients with CAI experience sprains, swelling, and pain. Particularly on uneven ground, during exercise, and due to weak or unstable ankles. A 10-61% of badminton injuries were ankle sprains [5]. Acute and repetitive injuries are caused by repetitive patterns, such as lunges, jumps, and quick directional changes; these movements exert high stress on both upper and lower extremities [5].

Plyometric exercise is recognised as an effective strategy for "reactive neuromuscular training" since it changes the motor unit recruitment pattern and muscle activity by facilitating the sensory motor system and increasing the excitability of the neurological receptors, thereby improving the reactivity of the neuromuscular

system [6]. Leg stiffness and running performance were improved in healthy teenagers aged between 12 and 15 with plyometric exercise alone. Plyometric training was utilised to optimise the performance of the athletes. These encompass strengthening or enhancing strength, power, velocity, and agility. Badminton requires the ability to stop, change direction, and start with explosive strength, all of which are common in plyometric workouts [7]. Balance is essential for badminton players in controlling their COG during challenging movements, including twisting actions during jump smashes (especially involving the pivot foot) and transitions between offensive and defensive positions [8]. Traditional FAI rehabilitation focuses primarily on balance and proprioceptive training to enhance postural control and prevent recurrence. While effective for improving coordination and joint position sense, these methods often fail to address the associated muscle strength, deficits, and imbalances [9]. It was reported that compared to Plyometric training alone, the combined training program incorporating balance training and Plyometric training can significantly enhance the dynamic balance (i.e., decreased sway length) and the quickness performance (i.e., faster time to complete dynamic balance tasks) of badminton players [10].

Dynamic support of eccentric muscle actions provided by the peroneal and tibialis anterior muscles is a key component in the prevention of a lateral ankle sprain when the ankle is forced into plantar flexion/inversion. Strengthening the ankle evertor muscles resulted in improvements in muscle strength and proprioceptive function, thus improving dynamic ankle stability and preventing recurrent inversion ankle sprains. These improvements were achieved through isokinetic concentric muscle strengthening or progressive resistance training programs [11].

The objectives of the current study are:

1) To compare the Effect of combined plyometrics and balance training in adjunct to conventional physiotherapy training on vertical jump, Sprint and agility in badminton players with functional ankle instability.
2) To compare the Effect of eccentric resistance training in adjunct to conventional physiotherapy training on vertical jump, Sprint and agility in badminton players with functional ankle instability.
3) To evaluate the Effect of conventional physiotherapy on vertical jump, Sprint and agility in badminton players with functional ankle instability.
4) To compare the Effect of combined plyometrics and balance training versus eccentric resistance training in adjunct physiotherapy training on vertical jump, Sprint and agility in badminton players with functional ankle instability.

Null Hypothesis:

H_0: There will be no significant difference on vertical jump performance, Sprint and agility in badminton players with functional ankle instability across the three intervention groups:

a) combined plyometrics and balance training with conventional physiotherapy;
b) combined plyometrics and balance training with eccentric resistance training and conventional physiotherapy and
c) conventional physiotherapy alone , nor will the experimental groups differ significantly from each other.

Alternate Hypothesis:

H_1: There will be significant effect of combined plyometrics and balance training with conventional physiotherapy on vertical jump, Sprint and agility in badminton players with functional ankle instability.

H_2: There will be significant effect of combined plyometrics and balance training with eccentric resistance training and conventional physiotherapy on vertical jump, Sprint and agility on badminton players with functional ankle instability.

H3: There will be significant effect of conventional physiotherapy on vertical jump, Sprint and agility in badminton players with functional ankle instability.

H4: There will be significant difference in vertical jump, sprint and agility among the badminton players with ankle instability receiving combined plyometrics and balance training versus eccentric resistance training in adjunct to conventional physiotherapy and conventional physiotherapy alone.

REVIEW OF LITERATURE

The combined application of plyometric, balance, and eccentric resistance training plays a significant role in addressing the functional deficits associated with FAI in badminton players. These interventions aim to improve neuromuscular control, proprioception, eccentric strength, and dynamic stability, thereby enhancing explosive power, speed, and the ability to change direction quickly.

The study conducted by Chandra S et al., demonstrated that a 3-week plyometric training regimen has increased badminton players' speed, agility, and jump performance [1]. Huang PY et al., concluded that Isolated plyometric training and integrated balance/ plyometric training both improve ankle joint position, recreational athletes with FAI and increase muscle activation of the ankle plantar flexors during the pre-landing phase [7].

Similarly, Guo C and Xu M reported that an 8-week combined balance and plyometric training intervention produced greater improvements in change-of-direction performance and significantly reduced lower limb injury risk in young badminton players compared to isolated plyometric training, suggesting that the addition of balance training enhances neuromuscular control and dynamic stability during high-intensity sport-specific movements. [8]. Furthermore, Hanci E et al., reported that a 6-week eccentric-concentric isokinetic training protocol significantly enhanced ankle evertor and dorsiflexor strength and improved proprioceptive acuity in subjects with FAI, suggesting that eccentric-based strengthening plays a critical role in improving dynamic stability and reducing recurrent instability episodes [11].

Surakhamhaeng A et al., reported that plyometric training significantly improved static and dynamic balance and enhanced ankle joint stability in individuals with FAI, indicating that plyometric exercises can be effectively incorporated into rehabilitation programs to optimise neuromuscular control and postural stability in FAI patients [12].

However, most of the previous studies have examined these components individually. Thus, the present study aims to evaluate the combined effect of plyometrics and balance training versus eccentric resistance training in addition to conventional physiotherapy training on vertical jump, Sprint, and agility in badminton players with FAI.

MATERIALS AND METHODS

The present three-arm parallel randomised controlled trial will be conducted at 1) Sports OPD, Ravi Nair Physiotherapy College, Sawangi, Wardha, Maharashtra, India, 2) District badminton court Wardha, Maharashtra, India from July 2025 to June 2026. The Institutional Ethics Committee approved it (ref No. DMIHER[DU]/ IEC/2025/612). The trial is registered with Clinical Trials Registry India (CTRI/2025/04/084395). All participants will provide written consent to participate in the study. Participants will be allotted according to inclusion and exclusion criteria.

Inclusion criteria:

- Athletes between the ages of 18-30 years;
- Recreational badminton players;
- Identification of Functional Ankle Instability (IdFAI) Questionnaire with a total score of ≥11, indicating that the participant was likely to have functional ankle instability[13].

Exclusion criteria:

- History of any significant lower limb injury or any neurological condition affecting balance;
- Athletes with acute ankle sprain (excluding sprains within 3 months);
- Participants who were unwilling to complete the rehabilitation program.

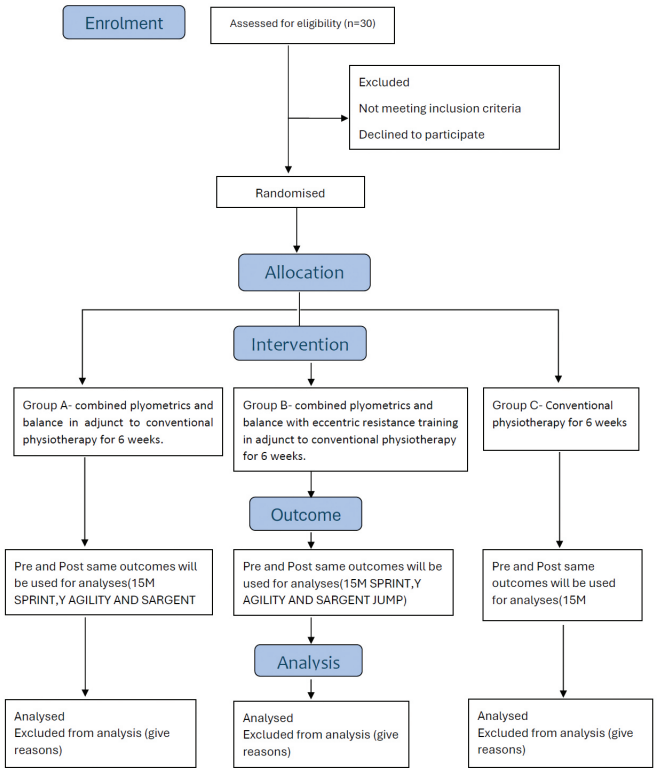
Sample size calculation: The sample size is calculated assuming equal variances and using Cohen's d for effect size:

d= Mean difference/Pooled Standard Deviation (SD)

Where pooled SD is calculated as:-SD pooled=$\sqrt{\{(s_1^2+ s_2^2)/2\}}$

By taking the primary variable as the Sargent jump [14]

- Mean±SD. (Pre) result on (Sargent jump performance) =26.70±5.17
- Mean±SD. (Post) result on (Sargent jump performance) =32.93±4.04



[Table/Fig-1]: Consolidated Standards of Reporting Trials (CONSORT) flow chart.

SD pooled=4.64

d=32.93 – 26.70/4.64=6.23/4.64=1.34

$N=2(Z\alpha+ Z\beta)^2/ \partial^2$

- n=sample size per group
- Zα=1.96 (for α=0.05, two-tailed)
- Zβ=0.84 (for 80% power)
- d=effect size (Cohen's d)

$$n = \frac{2(1.96+0.84)^2}{(1.34)^2} = 8.7$$

Required sample size ≈ 9 participants per group

For three groups=27 participants, i.e., nine participants per group.

On considering 10% of dropouts, the total sample size will be 30 i.e., 10 participants per group.

Participants will be randomised in a 1:1:1 ratio using computer-generated random numbers. Allocation will be concealed through the Sequentially Numbered Opaque Sealed Envelope (SNOSE) technique. The randomisation sequence will be generated by a blinded individual from a non healthcare background. The principal investigator will enrol participants, after which they will be assigned to groups and receive the respective interventions [Table/Fig-1].

To reduce the risk of contamination, participants will receive rehabilitation at a different time frame.

The first Group A (n=10) will undergo conventional training, along with combined plyometrics and balance training.

The second Group B (n=10) will go under conventional training, along with eccentric resistance exercises.

The third Group C (n=10) will undergo conventional training.

All the groups will receive training for three days/week for six weeks.

Interventional Group A: combined plyometric and balance training and conventional physiotherapy training for six weeks. To prevent injury and prepare participants for the exercises, all subjects will perform the same warm-up and cool-down routine. The exercise program will include different types of exercises, with the level of difficulty increasing gradually over the weeks [12]. Week-wise exercise program as follows [Table/Fig-2,3] [12,15].

Group B: In Group B, combined plyometrics and balance with Eccentric resistance training, along with conventional physiotherapy, will be given over a six-week resistance band protocol [Table/Fig-3, 4] [15]. Users will be asked to utilise only the involved ankle joint and to exercise at a uniform rate of around 3-5 seconds per repetition

Warm-up and cool-down	Balance training program				Plyometric training program	
	Phase (week)	Eyes	Surface	Exercise	Phase (week)	Exercise
Warm-up Side step jack, Jogging Double knee pulls, Jumping jacks	I (week 1)	Open	Floor	Single-leg stance Single-leg stance while swinging the raised leg Single-leg squat (30-45°) Single-leg stance while performing kicking [12]	I (weeks 1-2)	Ankle jump, Ski jump, Skater Squat jump [12]
	II (week 2)	Closed	Floor	Single-leg stance Single-leg stance while swinging the raised leg Single-leg squat (30-45°) Single-leg stance while performing kicking [12]		
Stretching (cool-down) Calf stretch Quadriceps stretch Hamstring stretch Inner thigh stretch Hip flexor stretch	III (week 3)	Open	Board	Single-leg stance Single-leg stance while swinging the raised leg Single-leg squat (30-45°) Double-leg stance while tilting the board [12]	II (weeks 3-4)	Heisman Low squat foot switch Two-feet front to back ankle, hop Two-feet side to side ankle hop [12]
	IV (week 4)	Closed Open	Board	Single-leg stance Single-leg stance while swinging the raised leg Single-leg squat (30-45°) Single-leg stance while tilting the board [12]		
	V-VI (weeks 5-6)	Closed Open	Board	Single-leg stance Single-leg squat (30-45°) Single-leg stance while tilting the board, Single-leg stance while performing kicking [12]	III (weeks 5-6)	Heisman Low squat in and out, one-leg ankle jump, One-leg side to side ankle hop [12]

[Table/Fig-2]: Training programs for the combined plyometrics and balance training [12].

Components	Details
Duration of program	6 weeks [15]
Frequency	Training on alternate days (≈ 3-4 sessions per week) [15]
Sessions per Day	Once daily [15]
Session structure	Warm-up → Resistance training → Stretching & relaxation [15]
Warm-up exercises	5 minutes; active joint movements of ankle and lower limb [15]
Resistance training (supervised)	Ankle movements against resistance: • Plantarflexion - 10 repetitions • Dorsiflexion - 10 repetitions • Inversion - 10 repetitions • Eversion - 10 repetitions [15]
Mode of resistance	Manual resistance provided by the therapist [15]
Stretching & muscle relaxation	Passive stretching after every session [15]
Stretching positions	Ankle plantarflexion, dorsiflexion, inversion, eversion [15]
Stretch duration	30 seconds each movement [15]
Cool-down	Included as part of the stretching and relaxation phase [15]

[Table/Fig-3]: Conventional physiotherapy [15].

Week	Protocol	
	Resistance (resistance band)	Sets /repetitions
1	Heavy (red) [15]	3/10
2	Heavy (red) [15]	4/10
3	Very heavy (green) [15]	3/10
4	Very heavy (green) [15]	3/15
5	Ultra-heavy (black) [15]	4/10
6	Ultra-heavy (black) [15]	4/15

[Table/Fig-4]: Eccentric resistance training with plyometric and balance training [15].

across the entire range of motion. Participants will increase the number of sets and band resistance each week [16].

Control Group C- Conventional Physiotherapy Training: Group C participants will receive conventional physiotherapy training for six weeks [Table/Fig-3] [15].

Study Procedure

The rehabilitation program will be consisted of warm-up exercises, weight training, and muscle stretching and relaxation. Training will be conducted once daily on alternate days for six weeks.

Warm-up exercises will take five minutes per exercise and included active joint movements. Resistance training will be performed under the supervision of a therapist, including ankle plantarflexion, dorsiflexion, inversion, and eversion, with 10 repetitions for each movement. Muscle relaxation and stretching will be carried out after every session in the form of passive ankle plantarflexion, dorsiflexion, inversion, and eversion muscle stretching for 30s each time [15].

Safety measures and adverse reaction management: Any significant side-effects are unlikely; the trial evaluators will closely observe for any unexpected incidents throughout and after the treatment. If any serious incident occurs, it will be reported to the ethics committee by the principal investigator and documented in the final study results.

Data management: To ensure accuracy, all data files will be screened for any inconsistencies. The designated data manager will be responsible for securely storing all materials related to data collection, whether in physical or digital format. Participants' private information will be safeguarded in password-protected databases. To maintain anonymity, each participant will be assigned a unique identification number. The identified data will be shared with the statisticians for analysis, ensuring participant confidentiality throughout the study

Study Outcomes

1. **Functional Ankle Instability (FAI) questionnaire:** The Identification of FAI (IdFAI) is a 10-item questionnaire specifically designed and developed to determine an individual's ankle stability status. It is scored from 0 to 37, with higher scores indicating worse instability. A total score of 11 or higher indicates a likely diagnosis of FAI [13].
2. **Sargent Jump Test (SJT):** To assess the SJT, athletes will hold the chalk in their right hand and stand near a wall. They will jump from the floor with free flexion of the lower limbs and mark the highest point possible on the wall. Each athlete will perform jumps for 45 seconds, and the highest mark reached will be recorded [17].
3. **15 m sprint test:** The 15-metre sprint test is used to assess speed and maximum acceleration in badminton players. Timers will be used to calculate the distance covered [18]. The ICC value is 0.86-0.92
4. **Y-shaped Agility test:** The Y- shaped Agility Test will be used to assess an athlete's ability to quickly change direction, which is important for performance in badminton.

   To assess, create a Y shape on the ground using cones. The base of Y should be 10 metres wide, and the arms of the Y should be 5 M from the centre point, forming a triangle with a 90-degree angle. After touching the apex, the participant must quickly change direction and sprint to one of the arms of the Y and touch that cone, then return to touch the apex again. A stopwatch will be used to record the total time taken from start to finish [19].

The assessment will be taken on the 1st day of recruitment and after the completion of the protocol, i.e., last day of the 6th week

STATISTICAL ANALYSIS

All statistical analyses will be conducted using Statistical Package for the Social Sciences (SPSS) version 25.0 software (IBM). Descriptive statistics will be used to summarise demographic variables and baseline characteristics. Continuous variables such as scores from the 15 m Sprint, Y agility test and Sargent jump test will be expressed as mean±SD. To assess within-group changes (pre vs post intervention), paired t-tests will be applied if data are normally distributed; otherwise, Wilcoxon signed rank tests will be used. For between-group comparisons (Group A vs Group B vs Group C), independent (unpaired) t-tests will be used for normally distributed data, and Mann-Whitney U tests for non parametric distributions. Additionally, Analysis of Covariance (ANCOVA) may be employed to adjust for any baseline differences. The p-value of <0.05 will be considered statistically significant. The Standard Protocol Items: Recommendations for Interventional Trials (SPIRIT) schedule of enrolment, interventions and assessments is demonstrated in [Table/Fig-5].

Study Period									
	Enrolment	Allocation	Post-allocation						Close-out
Timepoint**	-t1	0	1st week	2nd wee	3rd week	4th week	5th week	6th week	tx
Enrolment:									
Eligibility screen	X								
Informed consent	X								

Allocation		X							
Interventions:									
(Combining plyometric AND balance in adjunct to conventional training)				←	—	—	→		
Combining plyometric AND balance with eccentric resistance training in adjunct to conventional training)				←	—	—	→		
Conventional training				←	—	—	→		
Assessments:									
vertical jump	X								X
sprint	X								X
Y Agility test	X						.		X

[Table/Fig-5]: SPIRIT schedule of enrolment, interventions and assessments.

REFERENCES

[1] Chandra S, Sharma A, Malhotra N, Rizvi MR, Kumari S. Effects of plyometric training on the agility, speed, and explosive power of male collegiate badminton players. J Lifestyle Med. 2023;13(1):52-58. Doi: 10.15280/jlm.2023.13.1.52.

[2] Saini A, Dar AA. Optimizing jumping ability in badminton players through squat training. Front Health Inform. 2024;13(3):8210-15.

[3] Wong TKK, Ma AWW, Liu KPY, Chung LMY, Bae YH, Fong SSM, et al. Balance control, agility, eye-hand coordination, and sport performance of amateur badminton players: A cross-sectional study. Medicine (Baltimore). 2019;98(2):e14134. Doi: 10.1097/MD.0000000000014134.

[4] Fong DTP, Mok KM, Thompson IM, Wang Y, Shan W, King MA. A lateral ankle sprain during a lateral backward step in badminton: A case report. J Sport Health Sci. 2023 Jan;12(1):139-44. Doi: 10.1016/j.jshs.2021.03.007.

[5] Stepper B, Hecksteden A, Stagge H, Faude O, Donath L. Systematic review on badminton injuries: Incidence, characteristics and risk factors. BMJ Open Sport Exerc Med. 2025;11(1):e002127. Doi: 10.1136/bmjsem-2024-002127.

[6] Ebben WP, Simenz C, Jensen RL. Evaluation of plyometric intensity using electromyography. J Strength Cond Res. 2008;22(3):861-68.

[7] Huang PY, Jankaew A, Lin CF. Effects of plyometric and balance training on neuromuscular control of recreational athletes with functional ankle instability: A randomized controlled laboratory study. Int J Environ Res Public Health. 2021;18(10):5269. Doi: 10.3390/ijerph18105269.

[8] Guo C, Xu M. The effect of 8-week combined balance and plyometric training on change of direction performance of young badminton players. Sci Rep. 2025;15(1):21181.

[9] Huang D, Song W, Liu Y, Ke X, Wu Z. Isokinetic eccentric vs. concentric training for functional ankle instability: A randomized controlled trial. J Orthop Surg Res. 2025;20(1):775.

[10] Zhang L, Zhou L, Gong W, Jiang G, Bao D, Manor B, et al. The effects of six weeks of combined balance and plyometric training on postural control performance in elite badminton players: A pilot randomized, controlled study. Heliyon. 2024;10(14):e34080.

[11] Hanci E, Sekir U, Gur H, Akova B. Eccentric training improves ankle evertor and dorsiflexor strength and proprioception in functionally unstable ankles. Am J Phys Med Rehabil. 2016;95(6):448-58. Doi: 10.1097/PHM.0000000000000421.

[12] Surakhamhaeng A, Bovonsunthonchai S, Vachalathiti R. Effects of balance and plyometric training on balance control among individuals with functional ankle instability. Physiother Quart. 2020;28(2):38-45. Doi: 10.5114/PQ.2020.92474.

[13] Gurav RS, Ganu SS, Panhale VP. Reliability of the Identification of Functional Ankle Instability (IdFAI) scale across different age groups in adults. N Am J Med Sci. 2014;6(10):516-18.

[14] Ladriñán-Maestro A, Sánchez-Infante J, Martín-Vera D, Del-Blanco-Múñiz JA, Domínguez-Balmaseda D, Guzmán-Pavón MJ, et al. Effects of dry needling on vertical jump performance in female volleyball players. A randomized controlled trial. Front Sports Act Living. 2024;6:1470057. Doi: 10.3389/fspor.2024.1470057.

[15] Liu X, He M, Hu R, Chen Z. Randomized controlled trial study of intelligent rehabilitation training system for functional ankle instability. Sci Rep. 2024;14:4996. Doi: 10.1038/s41598-024-55555-y.

[16] Hall EA, Docherty CL, Simon J, Kingma JJ, Klossner JC. Strength-training protocols to improve deficits in participants with chronic ankle instability: A randomized controlled trial. J Athl Train 2015;50(1):36-44. Doi: 10.4085/1062-6050-49.3.71.

[17] De Salles PG, Vasconcellos FV, de Salles GF, Fonseca RT, Dantas EH. Validity and reproducibility of the Sargent jump test in the assessment of explosive strength in soccer players. J Hum Kinet. 2012;33:115-21. Doi: 10.2478/v10078-012-0050-4.

[18] Larsen MN, Ermidis G, Brito J, Ørner C, Martins C, Lemos LF, et al. Fitness and performance testing of male and female beach soccer players: A preliminary investigation. Front Sports Act Living. 2021;3:636308. Doi: 10.3389/fspor.2021.636308.

[19] Horníková H, Zemková E. Determinants of Y-shaped agility test in basketball players. Applied Sciences. 2022;12(4):1865. Available from: https://doi.org/10.3390/ app12041865.

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