IJBPAS, October, 2026, 15(10): 5089-5099

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

EFFECT OF HIGH INTENSITY INTERVAL TRAINING VERSUS PLYOMETRIC EXERCISE ON DYNAMIC BALANCE AND AGILITY IN SCHOOL VOLLEY BALL PLAYERS: A COMPARATIVE STUDY

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Received 15th Feb. 2026; Revised 16th March 2026; Accepted 10th June 2026; Available online 1st Oct. 2026

https://doi.org/10.31032/IJBPAS/2026/15.10.10565

ABSTRACT

Background: Volleyball is a dynamic sport that demands a high level of agility and balance for optimal performance and injury prevention, especially among adolescent players. Enhancing neuromuscular control during school-level training is essential for improving sport-specific skills such as jumping, landing, and rapid directional changes. Among various conditioning approaches, High- Intensity Interval Training (HIIT) and plyometric training are widely utilized to improve physical performance parameters in young athletes.

Methodology: The present comparative study was conducted to evaluate and compare the effectiveness of High-Intensity Interval Training (HIIT) and plyometric training on agility and dynamic balance in school-level volleyball players aged between 14–17 years. A total of 46 participants were selected through simple random sampling and were equally divided into two groups: Group A (HIIT) and Group B (Plyometric training), with 23 participants in each group.

Both groups underwent their respective training protocols for a duration of four weeks, with training sessions conducted six days per week

Results: Dynamic balance was assessed using the Y-Balance Test, while agility was evaluated using the Agility T-Test. Pre- and post-intervention measurements were recorded and statistically analyzed to determine within-group and between- group differences.

Conclusion: Based on the findings, it can be concluded that both HIIT and plyometric training are effective in enhancing agility and dynamic balance in school-level volleyball players. However, plyometric training appears to be more effective due to its close resemblance to sport-specific movements, thereby serving as a more targeted approach for improving functional performance and neuromuscular control in adolescent volleyball players.

Keywords: HITT, dynamic balance, agility, Y - balance test, plyometric

INTRODUCTION

School-aged children and adolescents represent an important developmental stage for improving physical fitness, neuromuscular coordination, and motor skills. Physical fitness is a multidimensional concept that includes musculoskeletal fitness, cardiorespiratory endurance, motor abilities, and body composition. These components collectively influence the ability to perform physical activities and are closely associated with both health outcomes and athletic performance in young populations **[1]**. Studies have demonstrated that higher levels of physical fitness during adolescence are associated with improved metabolic health, enhanced musculoskeletal development, better motor coordination, and reduced risk of chronic diseases later in life **[2]**. During adolescence, physiological maturation leads to increases in muscle fiber size, cross-sectional area, and contractile protein content, resulting in improvements in muscle strength and power **[3]**. Regular sports participation further promotes cardiovascular adaptations such as increased stroke volume, improved cardiac output, and enhanced oxygen utilization, thereby improving physical performance in youth **[4]**.

Despite the health and performance benefits of sports participation, young athletes remain susceptible to sports-related injuries, particularly when training loads exceed their developmental capacity **[5]**. Volleyball is one of the most widely played team sports worldwide and is associated with a considerable incidence of musculoskeletal injuries. Epidemiological studies have reported injury rates of approximately 10.7 injuries per 1000 hours of volleyball exposure, with the lower extremities being the most frequently affected region **[6]**. Common injuries include sprains, strains, contusions, and fractures resulting from

repetitive jumping, landing, and rapid directional movements involved in the sport **[7]**. Therefore, scientifically structured training programs are essential for improving athletic performance while minimizing injury risk among school-level volleyball players

Volleyball is characterized as a high-intensity intermittent sport that requires the integration of several physical fitness components including strength, speed, agility, endurance, flexibility, and explosive power **[8]**. Players frequently perform complex actions such as jumping, blocking, spiking, serving, and rapid changes in direction during gameplay. These movements require effective neuromuscular coordination and well-developed biomotor abilities to ensure optimal performance and movement efficiency **[9]**. Among these components, agility and balance are particularly important for maintaining postural stability and controlling body movements during rapid transitions on the court **[10]**.

Unlike endurance-based sports, volleyball involves short bursts of intense activity interspersed with brief recovery periods. The intermittent nature of the sport emphasizes the importance of anaerobic power and explosive lower-limb performance **[11]**. Vertical jumping ability is considered a key indicator of lower-body power and plays a crucial role in effective blocking and spiking actions during competition **[12]**. Consequently, training methods that enhance muscular power and neuromuscular efficiency are widely used in volleyball conditioning programs.

Plyometric training is an effective method for improving explosive strength and athletic performance. It utilizes the stretch-shortening cycle, in which a rapid eccentric contraction is immediately followed by a concentric contraction, resulting in greater force production and enhanced muscular power **[13]**. Exercises such as jumping, hopping, and bounding are commonly used in plyometric training and are particularly beneficial for sports that require explosive lower-limb actions, including volleyball **[14]**.

High-Intensity Interval Training (HIIT) is another widely used training strategy in athletic conditioning. HIIT involves repeated bouts of high-intensity exercise interspersed with short recovery intervals, enabling athletes to train at high workloads while stimulating both aerobic and anaerobic energy systems **[15]**. Previous studies have shown that HIIT can significantly improve cardiovascular fitness, metabolic efficiency, and repeated sprint performance in athletes **[16]**.

Dynamic balance is particularly important in volleyball as players frequently perform jumping, landing, and rapid directional changes during gameplay. Effective

neuromuscular control during these activities contributes to improved performance and reduced injury risk **[17]**. Agility refers to the ability to rapidly change direction or body position in response to a stimulus and involves a combination of speed, coordination, balance, and muscular power **[18]**.

Although both plyometric training and high-intensity interval training are widely used in sports conditioning, limited research has directly compared their effects on dynamic balance and agility among school-level volleyball players. Therefore, the present study aims to evaluate and compare the effects of High-Intensity Interval Training and Plyometric Training on dynamic balance and agility in school volleyball players.

Objectives

1. To evaluate the effect of High-Intensity Interval Training (HIIT) and Plyometric training on dynamic balance in school volleyball players using the Y-Balance Test.
2. To determine the effect of High-Intensity Interval Training (HIIT) and Plyometric training on agility in school volleyball players using the T-test.
3. To compare the effectiveness of High-Intensity Interval Training (HIIT) and Plyometric training on dynamic balance and agility in school volleyball players.

METHODOLOGY

- Study design:-comparative study
- Sample size:-23 participants per group (46 subject)
- Sample design:- simple random sampling
- Duration of the study:-1 year
- Duration of intervention:- High Intensity Interval Training for 6 days per week for 4 weeks and plyometric for 6 days per week for 4 weeks
- Study population:- school volley ball players matching with inclusion criteria
- Source of data:- Subject are collected from solaris public school
- Materials Required:- White tape, Inch tape, Stop watch, Pen, Paper, Consent form

Inclusion criteria

- School volley ball players
- Playing volley ball for at least 1 hour for 4 days per week
- Signed consent form from parents
- School players age of 14 -17 years
- School volley ball players who are participating willing
- Playing volley ball at city, state or national level

Exclusion criteria

- History with any injury of lower limb

(fracture, dislocation, sprain)

- Any operation of spine or lower limb (discectomy, laminectomy, spinal fussion)
- Cardiovascular disease (hypertension, arrhythmias, congenital heart disease)
- Rheumatologic disorder
- Individuals with any lower limb injury or surgery within last 1 year
- Individuals with any visual or vestibular problems
- Individuals who are physically challenged
- Individuals who don't wish to participate in the study

OUTCOME MEASURE

Y-Balance Test:

The Y-Balance Test was used to assess dynamic balance in the anterior, posteromedial, and posterolateral directions while the participant maintained a single-leg stance. Each participant performed six practice trials followed by three recorded trials for each direction on both legs. Reach distance was measured in centimetres and normalized to limb length to calculate the composite score.

Agility T-Test:

The Agility T-Test was used to measure agility and change-of-direction speed. Participants sprinted, shuffled laterally, and backpedalled between four cones arranged in a "T" shape. The best time out of three trials, recorded in seconds using a stopwatch, was used for analysis.

GROUP A HINGH INTENSITY INTERVAL TRAINING

Training Week	Exercise	Sets	Per day
I week	**10 minutes warm up** **1. Standard squats** **2. Stationary lunges** **3. Standard sit up** **4. Planks (10 second hold)** **10 minutes cool down**	**2 sets of 10 Repetition**	**2 times**
Ii week	**10 m inutes warm up** **1. Sumo squarts** **2. Reverse lunges** **3. Burpes** **4. Planks (15 second hold)** **10 minutes cool down**	**2 sets of 10 Repetitions**	**2 times**
Iii week	**10 minutes warm up** **1. Sid planks (10 second hold)** **2. Side to side squats** **3. V ups** **4. Curtsy lunge** **10 minutes cool down**	**2set of 10 Repetitions**	**2 times**
Iv weeks	**10 minute warm up** **1. Side plank (15 second hold)** **2. In and out squats** **3. V-up alternate legs** **4. Push up** **10 minutes cool down**	**2 sets of 10 Repetitions**	**2 times**

GROUP B PLYOMETRIC

Training Week	Exercise	Sets	Per day
I week	1. Wall jump 2. Squat jump 3. Lateral jump 4. Single leg bound	2sets of 10 Repetitions	2 times
Ii week	1. Double leg bound 2. Lateral cone hop 3. Lateral jump 4. Tuck jump	2 sets of 10 Repetitions	2 times
Iii week	1. Diagonal cone hop 2. Side to side ankle hop 3. 180^0 jumps	2 set of 10 Repetitions	2 times
Iv weeks	1. Lateral cone jump 2. Standing long jump 3. Side to side jump 4. Push up	2 set of 10 Repetitions	2 times

Statical analysis

The statistical analysis was done using SPSS software using. The normality of the data was checked using shapiro-wilk test with the p>0.005 is consider normal, most of the data in the following result is normally distributed so parametric test was used for the further analysis and confidence interval was set at 95%. Paired T-test was used to analyse the data within the groups while independent T-test was used to test the between the group variable with p<0.005 signify data significance.

RESULTS

DEMOGRAPHIC DATA

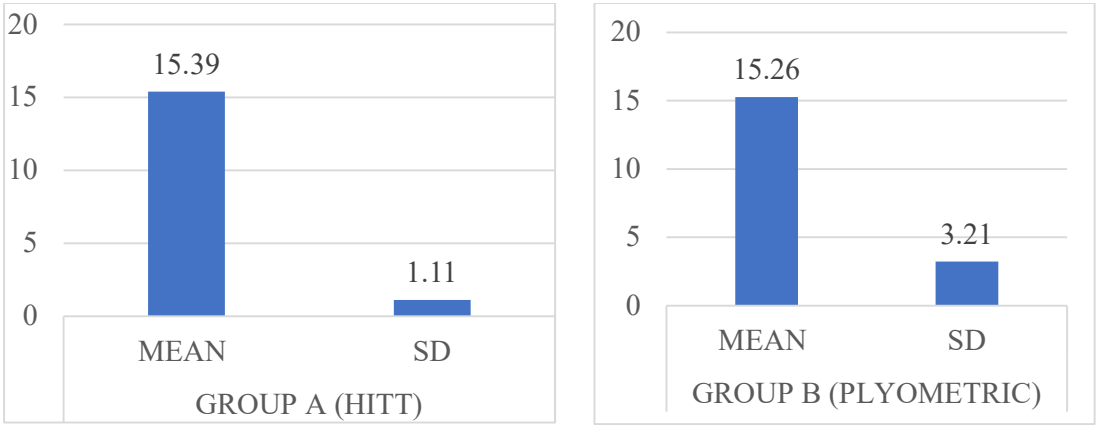


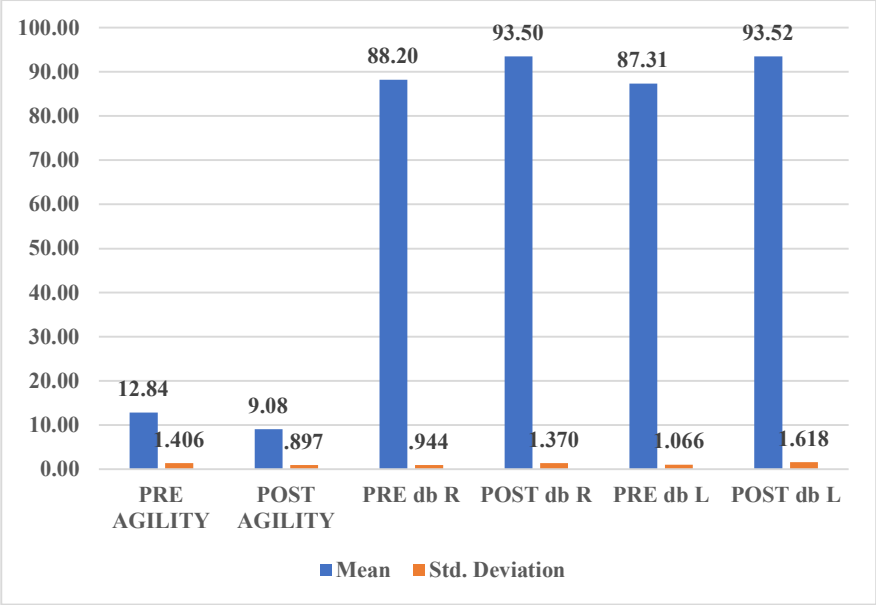
Chart 1: Mean±SD of Age IN Group A And Group B

Table 1: within the group analysis of pre and post data of group a HITT exercise

VARIABLE	Mean	Std. Deviation	P-VALUE
PRE AGILITY	12.84	1.406	0.005
POST AGILITY	9.08	.897	

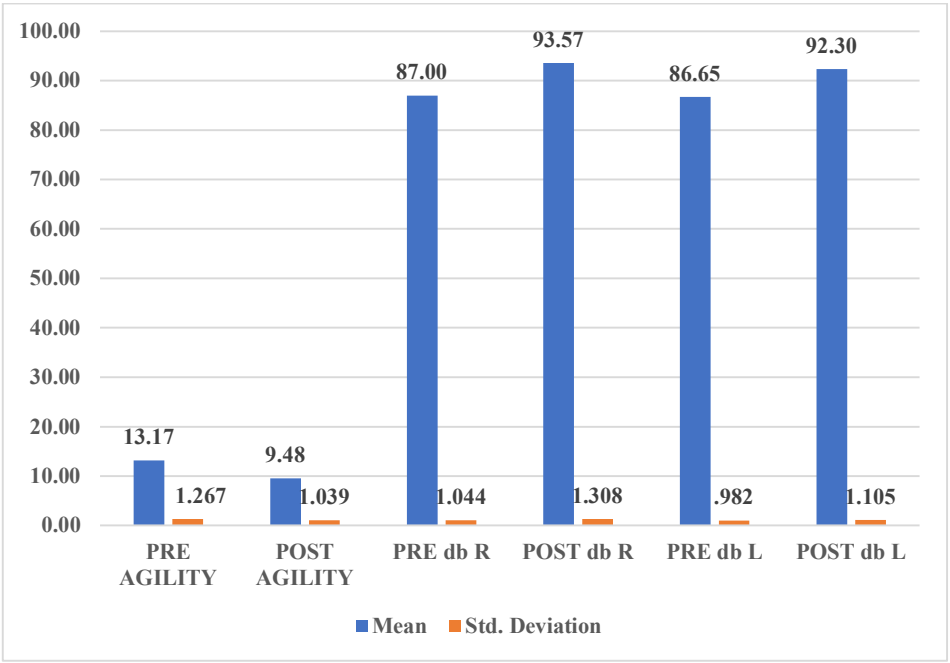
The above **Table 1** shows that the within the group comparison of pre and post value of T-Test for agility with p value 0.005.

GROUP A (WITH-IN)



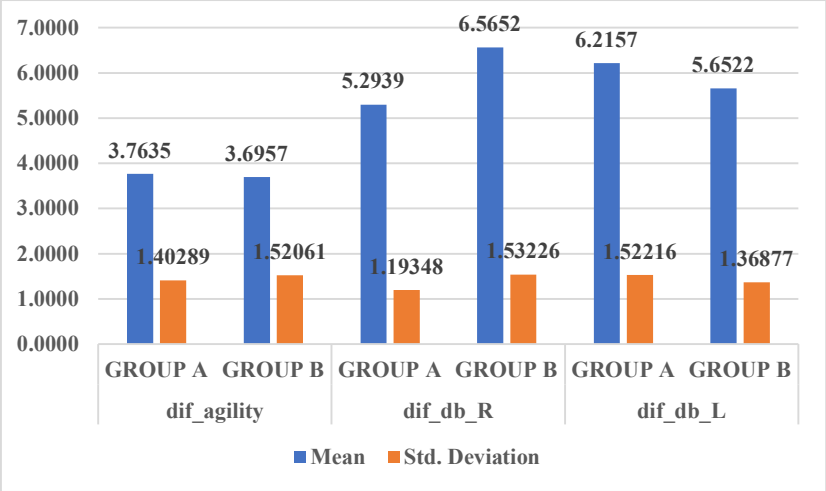
The above mentioned graphs states that group A HITT is effective in increasing agility (T-TEST) and dynamic balance (Y-BALANCE TEST) in both the legs

GROUP B (WITH-IN)



The above mentioned graphs states that group B Plyometric is effective in increasing agility (T-TEST) and dynamic balance (Y-BALANCE TEST) in both the legs

BETWEEN GROUP



The above-mentioned graph stated agility is almost similar in both the groups and dynamic balance was improved in right leg in group B while dynamic balance was improved in left leg in group A

DISCUSSION

The present study aimed to evaluate and compare the effects of **High-Intensity Interval Training (HIIT)** and **plyometric training** on **dynamic balance and agility** in school-level volleyball players. The results showed that both training interventions produced statistically significant improvements in agility and dynamic balance after four weeks of training, leading to rejection of the null hypotheses and acceptance of the alternate hypotheses.

Effect of HIIT on Dynamic Balance and Agility

The findings demonstrated that HIIT significantly improved **dynamic balance**, measured by the **Y-Balance Test**, and **agility**, measured by the **Agility T-Test**. HIIT involves high-intensity, multi-joint movements that challenge the neuromuscular system and enhance proprioceptive control during dynamic activities. Improvements in Y-Balance Test performance may be attributed to increased activation of core stabilizers and lower-limb musculature, which are essential for maintaining postural stability during unilateral stance and reaching tasks.

In addition, the significant reduction in Agility T-Test time observed in the HIIT group may be explained by improvements in neuromuscular coordination, metabolic efficiency, and the ability to perform repeated accelerations and rapid directional changes. Similar improvements in agility following HIIT interventions in volleyball players have been reported by Siti Nusrabina *et al*., supporting the findings of the present study.

Effect of Plyometric Training on Dynamic Balance and Agility

Plyometric training also resulted in significant improvements in both **dynamic balance and agility**. Plyometric exercises utilize the **stretch-shortening cycle**, which enhances proprioceptive feedback, joint stability, and neuromuscular coordination during dynamic movements. Similar improvements in Y-Balance Test performance following plyometric training in adolescent volleyball players have been reported by Akça and Baylan.

Comparative Effects of HIIT and Plyometric Training

Although both training methods significantly improved agility and dynamic balance, **plyometric training produced comparatively greater improvements**, particularly in agility performance. This may be due to the sport-specific nature of plyometric exercises, which closely replicate volleyball movements such as jumping, landing, and rapid directional changes. Previous research has also reported significant improvements in neuromuscular performance and agility following plyometric training in young athletes.

Overall, the findings suggest that both HIIT and plyometric training can be effectively incorporated into **school-level volleyball conditioning programs** to enhance agility and dynamic balance. However, plyometric training appears to be more effective for improving sport-specific neuromuscular performance in young volleyball players.

CONCLUSION

The results of this study suggest that plyometric and high-intensity interval training are equally useful for enhancing school-level volleyball players' agility and dynamic balance. Significant improvements were observed in both outcome measures following four weeks of intervention in each group. However, **plyometric training demonstrated superior improvement**, especially in agility performance and dynamic balance, when compared to HIIT. Therefore, the **null hypotheses were rejected,** and the **alternate hypotheses were accepted.** Plyometric training appears to be more effective due to its close resemblance to volleyball-specific movements such as jumping, landing, and rapid directional changes. Thus, plyometric exercises may be considered a more targeted and efficient training approach for enhancing functional performance and neuromuscular control in school volleyball players.

ACKNOWLEDGMENTS

Deepest appreciation to the researchers and practitioners whose dedicated efforts are significantly advancing the field of fall prevention science.

REFERENCES

[1] Ortega FB, Ruiz JR, Castillo MJ, Sjöström M. Physical fitness in

childhood and adolescence: A powerful marker of health. *Int J Obes*. 2008;32(1):1–11.

[2] Janssen I, Leblanc AG. Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. *Int J Behav Nutr Phys Act*. 2010;7:40.

[3] Malina RM, Bouchard C, Bar-Or O. *Growth, Maturation and Physical Activity*. 2nd ed. Champaign: Human Kinetics; 2004.

[4] Armstrong N, Welsman J. *Young People and Physical Activity*. Oxford: Oxford University Press; 2006.

[5] Emery CA. Risk factors for injury in child and adolescent sport: A systematic review. *Clin J Sport Med*. 2003;13(4):256-268.

[6] Bahr R, Bahr IA. Incidence of acute volleyball injuries: A prospective cohort study. *Scand J Med Sci Sports*. 1997;7(3):166-171.

[7] Reeser JC, Verhagen E, Briner WW, Askeland TI, Bahr R. Strategies for the prevention of volleyball-related injuries. *Br J Sports Med*. 2006;40(7):594-600.

[8] Fédération Internationale de Volleyball (FIVB). *Official Volleyball Rules*. Lausanne: FIVB; 2021.

[9] Sheppard JM, Gabbett TJ, Stanganelli LC. Analysis of playing positions in elite men's volleyball: Considerations for competition demands and physiologic characteristics. *J Strength Cond Res*. 2009;23(6):1858-1866.

[10] Ziv G, Lidor R. Vertical jump in volleyball players: A review of observational and experimental studies. *Scand J Med Sci Sports*. 2010;20(4):556-567.

[11] Sheppard JM, Cronin JB, Gabbett TJ, McGuigan MR, Etxebarria N, Newton RU. Importance of strength and power characteristics in elite volleyball jump performance. *J Strength Cond Res*. 2008;22(3):758-765.

[12] Forthomme B, Croisier JL, Ciccarone G, Crielaard JM, Cloes M. Factors correlated with volleyball spike velocity. *Am J Sports Med*. 2005;33(10):1513-1519.

[13] Komi PV. Stretch-shortening cycle: A powerful model to study normal and fatigued muscle. *J Biomech*. 2000;33(10):1197-1206.

[14] Markovic G, Mikulic P. Neuro-musculoskeletal and performance adaptations to lower-extremity plyometric training. *Sports Med*. 2010;40(10):859-895.

[15] Gibala MJ, Little JP, MacDonald MJ, Hawley JA. Physiological adaptations to low-volume high-intensity interval training in health and disease. *J Physiol*. 2012;590(5):1077-1084.

[16] Buchheit M, Laursen PB. High-intensity interval training, solutions to the programming puzzle. *Sports Med*. 2013;43(5):313-338

[17] Gribble PA, Hertel J, Plisky P. Using the Star Excursion Balance Test to assess dynamic postural-control deficits and outcomes in lower-extremity injury. *J Athl Train*. 2012;47(3):339-357.

[18] Sheppard JM, Young WB. Agility literature review: Classifications, training and testing. *J Sports Sci*. 2006;24(9):919-932.