Impact of Plyometric and Functional Training on Selected Physical Fitness Parameters among College-Level Volleyball Players

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ABSTRACT

Volleyball is one of the most popular sports in Tehrathum District. The research paper aimed to analyze improvements in speed using statistical tests, including the dependent't' test, ANCOVA, and Scheffe's post hoc test. This paper examines the impact of plyometric training with and without functional training on selected physical fitness variables of college Volleyball players in Tehrathum. The paper was conducted among 60 male Volleyball players from different colleges in the district, aged 17 to 24. The participants were randomly assigned to three groups: (1) Plyometric training with functional training (PT+FT), (2) Plyometric training without functional training (PT), and (3) Control group (CG). The 14-week training program was conducted five days per week, with sessions lasting 60 minutes in the morning. The findings indicate a significant improvement in speed in both experimental groups, with the PT+FT group showing the most progress.

Keywords: *Plyometric, Functional Training, Physical Fitness, Parameters, Volleyball Players*

Introduction

Volleyball game is a physically demanding sport requiring high levels of agility, speed, power, and endurance. The ability to perform explosive movements such as jumping, diving, and quick directional changes is crucial for success (Shahi, 2023). Functional training, on the other hand, is designed to improve movement efficiency by targeting core muscles, balance, and coordination, thereby reducing the risk of injuries (Daneshjoo et al., 2013).

Sports science has highlighted the role of specialized training methods in enhancing athletic performance, particularly plyometric and functional training. Plyometric training involves explosive, high-intensity movements that enhance muscular power and neuromuscular coordination (Markovic & Mikulic, 2010; Chelly et al., 2010).

Plyometric training, which includes explosive movements like jumping and bounding, is a key method used to improve athletic performance. When combined with functional training, which enhances core strength and stability, it can further boost performance.

Plyometric training is a specialized form of exercise that focuses on explosive movements to enhance power, speed, and overall athletic performance (Hewett et al., 2005). It is widely used in sports that require rapid acceleration, quick directional changes, and powerful jumps, making it highly beneficial for Volleyball players. This training method primarily involves exercises that utilize the stretch-shortening cycle (SSC), in which muscles rapidly lengthen (eccentric phase) before contracting forcefully (concentric phase). This process helps athletes develop greater force output and improved neuromuscular coordination (Egidi & Ntzoufras, 2020).

Plyometric training is a well-established method of improving explosive strength and athletic performance by utilizing rapid stretch-shortening cycles of muscles (Daneshjoo, et al. (2013). This type of training can take various forms, including jump training for the lower extremities and medicine ball exercises for the upper extremities, both of which are widely used in sports like Volleyball, basketball, and athletics (Haghighi et al., 2012). The primary goal of plyometric training is to enhance an athlete's power output by improving neuromuscular efficiency, motor unit recruitment, and tendon stiffness, which ultimately leads to better speed, agility, and force production (Markovic & Mikulic, 2010).

Jump training exercises, a crucial component of plyometric training, are classified based on their intensity and the relative demands they place on the athlete (Markovic, G., & Mikulic, P. 2010) These exercises follow a progressive training structure, where the complexity and intensity of movements increase over time to maximize adaptation and minimize injury risk (Hewett et al., 2005).

This training method is particularly beneficial for sports requiring rapid force production, such as Volleyball, basketball, and track and field events. When combined with functional training, which focuses on core stability, mobility, and movement efficiency, the benefits are further amplified. Several studies have demonstrated that plyometric training enhances vertical jump performance, sprint

acceleration, and agility. This study investigates the effectiveness of these training methods in the local context, aiming to provide insights for coaches and trainers working with Volleyball players in Tehrathum.

Methodology

Knapper and McIlwain (2015) have used the Massey method was originally conceived using final scores to determine ratings; however, it has been modified to include other statistics. Using this information, our strategy was to gather data from each team's match performances and make a prediction about the win/loss outcomes. Beginning in the third week of the conference play, we collected data from each of three statistical categories: match scores, total points per match, and number of kills. However, in this study, the pre-test and post-test scores were measured to compare the mean score and explore the variation between and within group differences.

A total of 60 volleyball players from various colleges in Tehrathum were selected using a random sampling method. First, a comprehensive list of all eligible volleyball players from the participating colleges was compiled. Each player was assigned a unique identification number. Using a computer-based random number generator, 60 numbers were drawn without any bias. The players corresponding to these numbers were selected for the study, ensuring that each individual had an equal chance of being chosen, thus maintaining the randomness and objectivity of the selection process.

The participants were between the ages of 18 and 25 years, ensuring that all players were within a competitive age group actively involved in Volleyball training. The selected players were divided into three equal groups, with each group consisting of 20 participants (n=20):

Group I – Plyometric Training with Functional Training (PT+FT, n=20): This group received both plyometric training and functional training. Plyometric training included jump squats, bounding drills, hurdle jumps, and sprint drills, while functional training focused on core strengthening, balance exercises, and agility drills. This combination aimed to enhance explosive power, coordination, and overall athletic performance.

Group II – Plyometric Training Only (PT, n=20): This group underwent only plyometric training, which included box jumps, depth jumps, and sprint acceleration drills. The focus was on developing lower-body explosiveness and speed without additional functional exercises.

Group III – Control Group (CG, n=20): This group followed their regular Volleyball training routine without any additional plyometric or functional training. The control group served as a baseline to assess whether the observed improvements in the experimental groups were due to the specific training interventions.

The training program lasted for 14 weeks, with sessions conducted three times per week in the evening for 90 minutes per session. The intensity and complexity of the training were progressively increased throughout the program to maximize adaptation and athletic improvement.

Training Schedule: All tests were conducted on standardized Volleyball grounds in Tehrathum to ensure uniformity in assessment conditions. Before the start of the tests, necessary markings were set up on the field, and each test was demonstrated and explained to the participants. The players were given practice trials to familiarize themselves with the testing procedures, ensuring accurate data collection. Maximum effort was encouraged from all participants during the testing phases.

Statistical Analysis

The collected data were analyzed using various statistical techniques to determine the effectiveness of the training programs. The following methods were used:

2.2.1 Dependent‘t’ test: To examine the significant improvement between pre-test and post-test scores within each group.
2.2.2 Analysis of Covariance (ANCOVA): To compare post-test results while accounting for pre-test variations among the three groups.
2.2.3 Scheffe’s Post Hoc Test: To determine specific differences between groups.
2.2.4 The significance level was set at 0.05, ensuring that any observed differences were statistically meaningful.

Results

The study's results were analyzed to assess the impact of plyometric training (with and without functional training) on speed. The dependent ‘t’ test and ANCOVA were applied to evaluate pre-test 2 and post-test scores across the three groups. The findings are summarized in Table 1 below.

Analysis of Covariance for Pre-Test, Post-Test, and Adjusted Post-Test Means on Speed

Unlike volleyball, in most sports (like basketball and football) there is a single performance outcome, namely the number of points or goals scored, which is measured cumulatively from the beginning to the end of the game. In these situations, a model with the total goals or points as a response is required. In contrast, in volleyball, the winner is announced in two stages or levels of outcomes: sets and points within each set (Egidi & Ntzoufras, 2020). In this study, the covariance is discussed to explore the variation in test scores. The results of covariance for pre-test, post-test and adjusted post-test means are shown in Table 1.

Table 1

Analysis of Covariance for Pre-Test, Post-Test, and Adjusted Post-Test Means on Speed

Group	Pre-Test Mean	Post-Test Mean	Adjusted Post-Test Mean
PT+FT (Group I)	7.50	6.40	6.41
PT (Group II)	7.52	6.55	6.52
Control Group (Group III)	7.54	7.70	7.72

The table presents the mean values of speed (measured in seconds) for each group at three different stages: pre-test, post-test, and adjusted post-test. These values help in understanding the impact of plyometric training with and without functional training on speed performance among college male Volleyball players in Tehrathum District.

Thus, as mentioned by Stamm, Stamm, & Koskel (2006) in their study of all classes the total number of girls who performed the respective elements was calculated, differentiating between the total number of serves, attacks, and blocks performed and the number of those that ended by winning a point. They also calculated for each class and the mean index of proficiency was calculated for serve, reception, attack, and block performances for the whole tournament (Stamm, et al. 2006). However, in this case between and within group comparison is made to explore the variation.

Pre-Test Mean (Baseline Performance)

The pre-test mean represents the initial speed performance of the players before any training intervention. All three groups started with similar speed levels, with minor differences in their mean values (7.50, 7.52, and 7.54 seconds). This indicates that there was no significant difference in speed among the groups at the beginning of the study.

Post-Test Mean (Effect of Training after 14 Weeks)

The post-test mean represents the speed performance after 14 weeks of training. The PT+FT group (6.40s) showed the greatest improvement in speed, followed by the PT group (6.55s). The Control Group (7.70s) did not show improvement; instead, there was a slight increase in time (which suggests no enhancement in speed performance). This indicates that both plyometric training and functional training contributed to speed enhancement, with the combination of both methods yielding the best results.

Adjusted Post-Test Means (Statistically Adjusted for Fair Comparison)

The adjusted post-test mean accounts for any pre-existing differences among the groups, ensuring a fair comparison using statistical adjustments (ANCOVA). The values remain similar to the post-test results, confirming that the PT+FT group (6.41s) achieved the best improvement, followed by the PT group (6.52s). The Control Group (7.72s) still showed no significant improvement, reinforcing the importance of structured training.

Analysis of Variance for Speed Performance:

The table presents statistical analysis results examining the effect of plyometric training with and without functional training on the speed of inter-collegiate male Volleyball players in Tehrathum. The data were analyzed using Analysis of Covariance (ANCOVA) to compare pre-test, post-test, and adjusted post-test results across the three groups.

Pretest Score Analysis Elida and Ntzoufras (2020) have reported in their work that they have followed the approach of modeling both outcomes of volleyball: sets and points. While doing so, the response data are richer in terms of information which enabled them to estimate team abilities more accurately and to increase the prediction accuracy of our model. However, in this case, the difference in pre-test scores was computed to analyze the variance.

Table 2

Pre-Test Scores Analysis

Source of Variance	Sum of Squares	df	Mean Squares	F-ratio
Pre-Test Scores	0.002	2	0.001	0.51

The pre-test scores indicate that there was no significant difference in speed among the three groups before the training intervention began. The Sum of Squares (0.002) is very low, indicating minimal variation among the groups. The F-ratio (0.51) is much lower than the critical value required for statistical significance at the 0.05 level, confirming that all groups had a similar baseline in speed before training. This result is important because it ensures that any improvements observed in the post-test are due to the training interventions rather than pre-existing differences among the groups.

Post-Test Scores

Analysis Stamm, Stamm, and Koskel (2006) have studied about the proficiency of girls in playing games. Based on their study, Stamm, Stamm, and Koskel (2006) reported that the girls' proficiency in the game for the whole tournament was assessed in the same body build classes. For each class, the total number of serves, receptions, attacks, and blocks, their mean values per player, and the percentage of elements performed during the whole tournament were calculated. In the same way, they calculated for each class the total number of points scored and, separately, the number of points scored by serve, attack, and block. However, in this study, the variation is mentioned only based on pre-test and post-test scores of the players.

Table 3

Post-Test Scores Analysis

Source of Variance	Sum of Squares	df	Mean Squares	F-ratio
Post-Test Scores	13.22	2	6.611	109.51*

The post-test scores show a significant improvement in speed among the experimental groups compared to the control group. The Sum of Squares (13.22) is significantly higher than the pre-test scores, indicating greater variation between the groups after training. The F-ratio (109.51) is much higher than the critical value at the 0.05 level, confirming a statistically significant difference in post-test speed performance among the groups. This means that both plyometric training groups (PT+FT and PT) experienced substantial improvements in speed, whereas the control group did not.

Adjusted Post-Test Scores Analysis

For the accuracy of prediction (Knapper & McIlwain, 2015) wanted to predict as

accurately as possible the outcomes of volleyball games. To make these predictions, they used our understanding of the sport to help us pick data sets to analyze. They then used our understanding of mathematical ranking methods to analyze the data. Based on the forecast accuracies of our prediction, we observed that studying several different types of statistics (not only match scores) could produce differing predictive results. Rating and ranking athletic teams involves understanding mathematics, understanding sports, and making good choices about which data sets to study (Knapper & McIlwain, 2015). However, in this study, the adjusted post-test scores were analyzed. The results of the post-test scores are shown in Table 4.

Table 4

Adjusted Post-Test Scores Analysis

Source of Variance	Sum of Squares	df	Mean Squares	F-ratio
Adjusted Post-Test Scores	13.04	2	6.52	110.27*

The adjusted post-test scores account for any minor variations in the pre-test scores, making the comparison more precise. The Sum of Squares (13.04) remains high, reinforcing the significant variation among the groups after training. The F-ratio (110.27) is again very high and statistically significant at the 0.05 level, confirming that the differences in speed improvement between the groups were not due to chance. The PT+FT group demonstrated the most significant improvement, followed by the PT group, while the control group showed minimal progress.

Findings

4.1. Significant Improvement in the Experimental Groups: Both PT+FT and PT groups showed notable reductions in sprint time, indicating that plyometric training improves speed and that functional training enhances these effects even further.

4.2. Superior Performance of PT+FT Group: The group that combined plyometric and functional training achieved the greatest improvement in speed, suggesting that functional exercises contribute additional benefits, such as better movement efficiency, core stability, and neuromuscular coordination.

4.3. Lack of Improvement in the Control Group: The control group, which followed only their regular training routines, did not show improvement in

speed. This suggests that general Volleyball training alone may not be sufficient to enhance sprint performance, and specialized training programs are necessary.

4.4. There was no significant difference between the three groups in pre-test speed scores (F-ratio = 0.51).

4.5. The post-test scores showed a significant difference (F-ratio = 109.51, $p < 0.05$), indicating that the experimental groups improved more than the control group.

4.6. The adjusted post-test scores also showed a statistically significant difference (F-ratio = 110.27, $p < 0.05$), confirming that both experimental groups experienced notable improvements in speed compared to the control group.

4.7. The PT+FT group showed the greatest improvement, suggesting that combining plyometric and functional training yields better speed enhancement than plyometric training alone.

Conclusion

Collings (2007) highlighted that Sandefur presented an analysis of the probability of winning a deuce game in tennis (that is, any game that is tied at three points or more). Because a player must win by at least two points, this analysis led naturally to a geometric series representation of the probability that the server wins the game. There is an alternative approach to the problem that does not rely on geometric series. This study based on the mean comparison and F-test comes to conclusion on the effect of plyometric training among Volleyball players.

The findings confirm that plyometric training significantly enhances speed, and when combined with functional training, the results are even better. Coaches and trainers in Tehrathum should consider incorporating both training methods into their Volleyball programs to maximize athletic performance.

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