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EFFECTS OF A TEAMWORK INTERVENTION ON VOLLEYBALL-SPECIFIC PERFORMANCE: A RANDOMIZED TRIAL

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ABSTRACT

Interventions based on teamwork have been receiving the growing interest of sport psychology as means of increasing attentional regulation, emotional regulation, and stability of performance in the presence of competition. This paper has discussed the impact of an eight-week team-based intervention on technical performance of university level female volleyball players on volleyball specific performance. Randomly chosen were twenty-eight volleyball players between the ages of 18-22 years (n = 14) who were exposed to experimental group, with 14 players who received 30-35 minutes of teamwork intervention per day followed by regular volleyball training, or control group with 14 players who only received regular volleyball training. The load during training was normalized to groups and observed to ensure homogeneity. The performance in volleyball was measured prior to and after the intervention using the standardized skill test battery, which comprised of forearm pass, overhead pass, serve, spike, and block accuracy measures. The experimental group showed much more improvements in the overall technical performance than the control group. The greatest improvement in performance was recorded in serves and spike accuracy. The findings show that teamwork-based training can be used as a complementary method of training in volleyball, particularly in technical and physical training, to facilitate skill performance and consistency in the field.

Keywords: *teamwork; Mindfulness Meditation Training for Sport volleyball; skill accuracy; sport psychology; randomized controlled trial*

INTRODUCTION

Teambuilding interventions have been gaining growing interest in sport psychology as methods
to improve attentional control, emotion management and consistency in performance during competition. This paper has discussed how a teamwork based intervention lasting eight weeks can influence volleyball specific technical performance in elite female athletes. An experimental group (n=14) and a control group (n=14) were randomly selected consisting of 28 volleyball players aged 18-22 years old and were assigned either to an experimental group (participating in daily teamwork sessions of 30-35 minutes prior to regular volleyball training) or a control group (participating in regular volleyball training only). The training load was also standardized in groups and checked to ensure uniformity. The measure of volleyball performance before and after the intervention was done using a standardized skill test battery, which consisted of measuring forearm pass, overhead pass, serve, spike, and block accuracy levels. The experimental group showed much more enhancement in the overall technical performance than the control group. This was maximum increase in performance in serve and spike accuracy. These results suggest that teamwork-based training can also be an effective supplement to technical, physical training to volleyball to facilitate the performance and skill execution under competitive conditions. Club level athletes are often subjected to severe psychological and physiological demands that demand deep concentration, quick decision-making and competence to remain at their best despite pressure. Regulation of emotions, staying calm, and being able to maintain concentration during critical situations is a vital factor in the outcome of the performance in particular team sports like volleyball. This has made researchers and practitioners have been quick to investigate psychological interventions that can address attentional control, emotional regulation and resilience in competitive settings. Teamwork based strategies have received significant attention as evidence based intervention in enhancing the psychological functioning and performance of athletes. Teamwork has been linked to the increased attentional focus, decreased competitive anxiety, and increased performance consistency as the result of non-judgmental awareness of the present moment [1, 2]. In sport, there are several interventions applied to teamwork, including the **Acceptance and Commitment Training (AC Training)** [3] and Mindful Sport Performance Enhancement (MSPE) [4, 5], which have demonstrated positive outcomes in terms of psychological skills, flow state, and performance under pressure. Mindfulness Meditation Training of Sport (MMTS) and its revised counterpart MMTS-2 have become the most common example of teamwork-based interventions as well as structured sport-specific interventions aimed at merging teamwork concepts with the demands of a competitive sport [6]. MMTS-2 focuses on contextualized practice and training in scenarios, which allows athletes to apply teamwork skills in actual competition scenarios. Investigations using collegiate athletes have shown that MMTS is capable of enhancing teamwork, acceptance, and perceived ability to remain focused under pressure [7, 8], and qualitative assessments indicate that athletes feel improved coping mechanisms as well as enhanced composure during a competition when they are given MMTS-2 [9, 10]. Nevertheless, empirical studies on the use of MMTS-2 with young elite team sports have not been extensively conducted with reference to objective outcomes of performance, specifically skills accuracy. The structured and scenario-based nature of MMTS 2 could be particularly applicable to the setting of athletes who play volleyball in a fast-paced and dynamic setting as focus and composure in a stressful situation are essential. Thus, this research was meant to investigate the impact of an 8-week intervention of MMTS-2 on volleyball skill accuracy among elite female volleyball athletes at the age of 18-22 years. Our hypothesis was that athletes who went through MMTS-2 would show more improvements in skill accuracy than a control group who only went through the regular volleyball training.

Methods

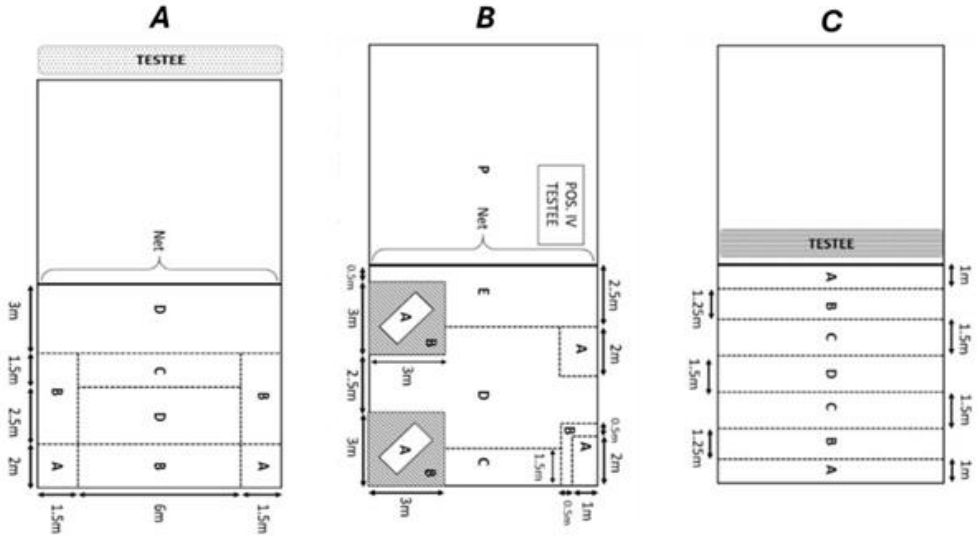
Before participation, participants and child assent forms were taken. There were 28 female volleyball players (18-22 years old) who were willing to take part in the study. The participants were all aged above three years with a minimum of three years of volleyball experience and they were training seven days a week. All of the participants were given informed consent in written form. Regarding the informed consent of parents on behalf of athletes in the age of less than 18 years old, the subjects were randomly classified in experimental group (n = 14) and control group (n = 14). Age and anthropometric characteristics were similar between the experimental group (M +- SD: age = 17.71 +- 0.85 years; height = 184 +-3.40 cm; weight = 73.8 +- 7.24 kg; body fat = 14.08 +- 1.46) and the control group (M plus-SD: age = 17.88 +- 0.86 years; height = 183 +- 6.07 cm; weight = Albeit, a priori power analysis was not performed prior to the study, a post hoc sensitivity analysis was done using G + Power 3.1.9.7 (F tests; repeated-measures ANOVA, within-between interaction; a =.05; 1(?)b=.80; pre-post correlation assumed=.50). With a final sample size (N = 28), the design was sensitive to interaction effects with at least f = 0.275 (e 2 =.070). Interestingly, this threshold lies in the range of what Cohen [11] regards as medium interaction effects. Additionally, the values of all the Group x Time interaction effects observed in this research were above this sensitivity level which implies that the sample size was sufficient to capture the magnitudes of effects of interest.

Measures

Volleyball skill tests Standardized volleyball skill tests were conducted to measure the volleyball-specific performance of the participants based on the protocols of the standardized volleyball skill tests designed by Zonifa.,et al. [12] and Bartlett.,et al. [13]. The accuracy, spike accuracy, block accuracy, forearm pass accuracy, and overhead pass accuracy were tested.

Serve accuracy test

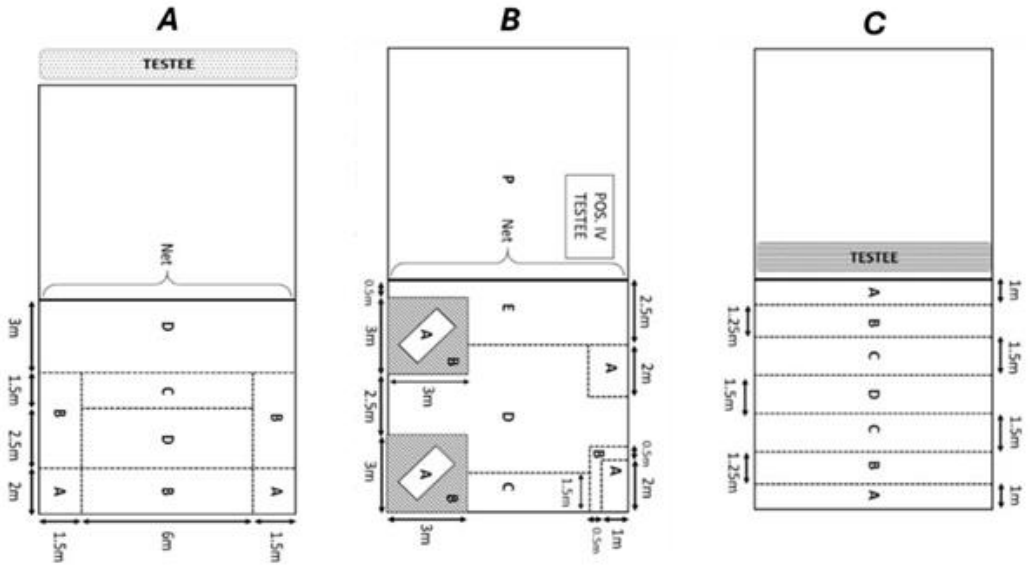
Each of the participants gave five serves based on the serve accuracy protocol [12]. The points were earned depending on the landing zone of the ball: Zone A = 4 points, Zone B = 3 points, Zone C = 2 points, Zone D = 1 point, and out-of-bounds or net faults = 0 points (Figure 1). In the case when a ball fell on a line between the zones, the larger score was given. This test had a maximum mark of 20 points. Maximum 20 point spike accuracy test



(Figure1). Block tests. The maximum score was 20 points.

After the spike accuracy procedure [12], the participants were asked to undergo five self-set spike attempts at position 4 (left front) and then they were left alone to do them. The zone-based scoring system used to score each spike was the

same as they were scored in the serve accuracy test, Block performance was measured by following the block test protocol by Zonifa.,et al. [12]. In position 4, the participants tried to block five balls of attack thrown across the net by a professional volleyball coach.



(Figure1). A blocked ball was awarded the same scoring as the serve and spike Figure 1 based on the point of landing of the ball. Skill tests in volleyball. A = Serve Accuracy Test, B = Spike Accuracy Test, C = Block Test.

Forearm Pass Test

The accuracy of forearm pass was assessed with the help of the test protocol created by Bartlett et al. [13]. The participants were made to repeat ten forearm passes (living five passes on the right side and five passes on the left side reception) in response to underhand serves by an experienced coach. The passes were required to cross a rope that was set about 2.40 m high and fall in specific target areas in the front court. The scoring in the protocol was based on a scoring chart, and the Chapter received a maximum of 50 points.[13] claimed that the Cronbach's alpha reliability coefficient of this test was.76 in the pre-test and.77 in the post-test.

Overhead pass test

The performance of overhead pass was measured based on the protocol created by Bartlett et al. [13]. In the backcourt (zone 5), the participants moved behind a marker cone, which was placed below the ball and performed an overhead pass over a rope positioned at 3.55 m. Depending on which target zone was hit, the points were awarded, including 0 to 5 per attempt. Passes that were not regulated were attributed to 0, and invalid tosses were done again. The maximum total score was 50. The initial Cronbach's alpha reliability took was.86 in the pre-test and.82 in the post-test [13].

The maintenance of procedure and MMTS-2 interventions, which target zones, were maintained the present study was based on the randomized controlled study design and pre- and post-test results. The simple randomization process was used in assigning participants into either the experimental (MMTS-2) group or the control group. The two populations remained in their usual volleyball training that was structured with an average intensity of 50-90 per cent of maximum heart rate and structured into monocycles, micro cycles, and daily drills. The heart rate monitors used to monitor training intensity were Polar H10 (Finland) with a connection to iPad compatible software to facilitate The study to be carried out in the spirit of the Declaration of Helsinki. The GC

University Faisalabad provided the ethical approval. Informed consent was obtained in writing, and consent forms of parents and children under 18 years old were gathered before the participation. Every participant was advised that he was not obliged to participate when he or she was not willing to participate and he could pull out of the study any time. Data were anonymized and confidentiality was ensured during the analysis. The intervention protocol was the Teamwork Meditation Training of Sport 2.0 (MMTS-2) as presented by Baltzell and Summers [14]. Eight weeks of consecutive sessions of seven days a week were carried out before volleyball training. The duration of the sessions was roughly 30-35 minutes. The MMTS-2 program presents the skills of working in teams in a gradual manner and has sport-specific and scenario-based activities, which enhance the focus of athletes and their psychological readiness to play. Some of the major elements highlighted in the curriculum include mindfulness breathing, present-moment awareness and body awareness exercises as outlined in MMTS-2. Reflections on scenarios were scaled to suit the situations that are encountered in volleyball training and competition (e.g., under pressure service, match-point situations). The entire sessions of MMTS-2 were done by a qualified psychologist, and volleyball drills were done by professional volleyball coaches. The 8-week program performance was evaluated with the help of a standardized volleyball skill battery (forearm pass, overhead pass, serve, spike, and block tests) and the accuracy scores of every skill were measured under the same testing conditions in both groups.

Data Analysis

All statistical tests were done with Jamovi software (Version 2.3.28). In order to assess the impact of MMTS intervention, mixed-design ANOVA (Group x Time) was conducted on each of the dependent variables (serve accuracy, spike accuracy, block accuracy, forearm pass accuracy and overhead pass accuracy). Before conducting the ANOVA, the normality and homogeneity of the variances assumptions were checked with the help of the diagnostic tests inbuilt in Jamovi. The homogeneity of variances was tested with the help of Levene and the normality was tested with the help of Shapiro-Wilk tests. None of the assumptions were violated seriously. In all the analyses, 95% confidence intervals (CI) were provided in addition to the mean values. Eta squared (e2) and omega squared (o2) were used to calculate and report the effect sizes so as to give a solid interpretation of the strength of the effects. The p value of 0.05 was used as a statistical test.

Pre-test	11.7	0.580	10.6	12.9	11.6	0.58	10.5	12.8	G	14.1**	.129	.119	< .001
Post-test	17.0	0.580	15.8	18.2	12.7	0.58	11.6	13.9	T	30.0**	.275	.263	< .001
									GxT	13.2**	.121	.111	< .001
Spike Accuracy													
Pre-test	10.6	0.366	9.91	11.4	10.2	0.366	9.48	10.9	G	49.3**	.251	.245	< .001
Post-test	15.6	0.366	14.91	16.4	10.9	0.366	10.19	11.7	T	60.8**	.310	.303	< .001
									GxT	34.2**	.174	.168	< .001
Block Accuracy													
Pre-test	10.4	0.566	9.22	11.5	12.7	0.56	11.5	13.9	G	0.572	.006	-.004	0.453
Post-test	15.5	0.566	14.36	16.6	14.0	0.566	12.86	15.1	T	32.202**	.334	.320	< .001
									GxT	11.593**	.120	.109	< .001
Forearm Pass Accuracy													
Pre-test	21.0	0.600	19.8	22.2	19.9	0.600	18.7	21.1	G	39.8**	.210	.203	< .001
Post-test	29.0	0.600	27.8	30.2	22.5	0.600	21.3	23.7	T	77.5**	.409	.401	< .001
									GxT	20.4**	.108	.102	< .001
Overhead Pass Accuracy													
Pre-test	18.4	1.22	16.0	20.9	17.3	1.22	14.8	19.7	G	12.13**	0.138	0.125	< .001
Post-test	26.6	1.22	24.2	29.1	19.3	1.22	16.8	21.7	T	17.51**	0.199	0.185	< .001
									GxT	6.48*	0.074	0.062	.014

The table shows the data on the Impact of teamwork intervention on volleyball-specific performance, and the measurements of the performance indicators were measured at the pre-test and post-test stage. It takes a comparison between two groups (G and T), with a possible interaction (GxT). Four important areas of volleyball performance, including spike accuracy, block accuracy, forearm pass accuracy, and overhead pass accuracy are the subject of the table. Analysis of the results is done using the statistical measures of means, standard deviations and level of significance (p-values) of each of these performance measures.

The initial measure that is measured is spike accuracy where the information indicates that there have been great improvements in the post-test and pre-test of the two groups. The average spike accuracy of Group G is 10.6 and that of Group T is a bit lower at 10.2 and the standard deviations show that there are small deviations. Following the intervention, there is a significant improvement in both groups with similar average of 15.6 of Group G and 10.9 of Group T. A high effect size ($F = 49.3$, $p < .001$) underlines this improvement in that the teamwork intervention had a positive effect on spike accuracy. Interaction effect (GxT) also plays an important role, which also underlines the impact of the intervention between the groups.

The second performance measure is block accuracy, which exhibits a less radical pre-test-to-post-test effect as compared to spike accuracy. There is minimal change in the pre-test averages of Group G (10.4) and Group T (12.7) and the post-test average score is raised to 15.5 and 14.0 respectively. The post-test values are more, but the change is less significant, as indicated by the smaller value of F (32.202, $p < .001$). The GxT interaction of accuracy of blocks also attains significance ($p < .001$), indicating that the effect of teamwork intervention was different on the two groups.

There is a greater improvement in forearm pass accuracy and this is especially in Group G. Pre-test scores reveal that Group G was at 21.0 and Group T at 19.9 and Group G has made more improvements. The Group G scores go up to 29.0 as compared to 22.5 in Group T. This measure has a strong impact of the teamwork intervention and the F-value is large (77.5, $p < .001$), which reveals that the intervention had significant impact on forearm pass accuracy. The interaction (GxT) is also

relevant, which once again proves the intervention effect in both groups.

Last, there is an impressive increase in overhead pass accuracy in both groups, although there are not as significant differences. The pre-test scores indicate that Group G had a score of 18.4 and Group T had a score of 17.3 while the post-test scores had increased to 26.6 in Group G and 19.3 in Group T. The analysis of the statistical data presents a significant effect of teamwork intervention, F-value 17.51 ($p < .001$). This measure is also significant in the GxT interaction ($p = .014$), which implies the intervention influenced differentially by the group.

All in all, the table gives great support towards the effectiveness of the teamwork intervention on the volleyball-specific performance. On all four performance indicators, both groups show a substantial improvement in terms of performance with the most significant effect on the spike accuracy, forearm pass accuracy, and overhead pass accuracy. The interaction effects show that the performance of the intervention can be a bit different between the groups, and it is evident that the teamwork can affect volleyball results in a positive manner, especially in skill-related factors such as passing and spiking.

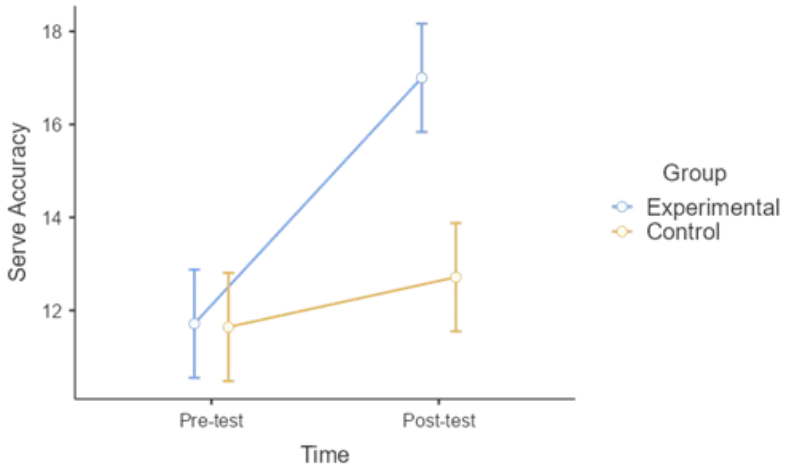


Figure 2: Interaction between group and time for Serve Accuracy

The figure gives accuracy scores of figures in the experimental and control groups at the post test and pre-test. The level of accuracy of serving was incredibly similar in the two groups at pre-test. The means of the experimental group disappeared around 11.7 and the means of the control group were around 11.6. The error bars show that there is an equal amount of variation in the levels of either group at baseline. Differences between the groups were increased at post-test. The mean serve accuracy of the experimental group rose significantly to about 17.0 indicating a significant improvement compared with pre-test. However, the mean of the control group rose rather marginally to approximately 12.7. Throughout the time, the experimental group had shown significant increase in accuracy when throwing the serves, but there was minimal increase in the control group. The difference between groups increased at post-test where the experimental group performed better than the control group. The non-parallel mechanism of the lines also reflects the levels of interaction between the group and time, where the alteration of the accuracy of the serves in time in one group was different than in the other group.

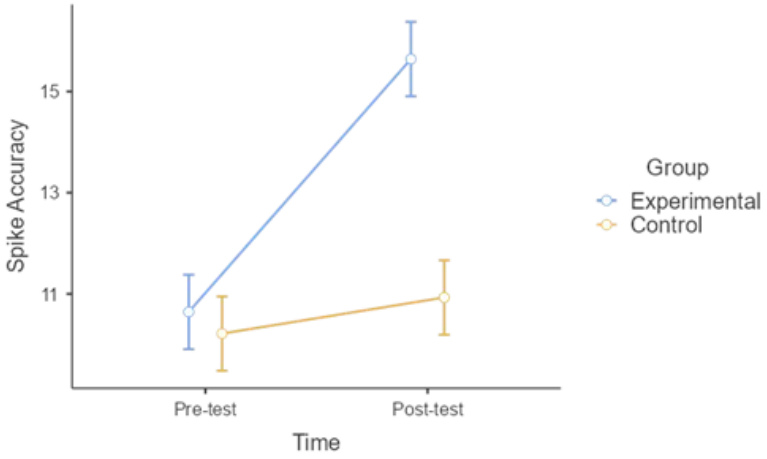


Figure 3: Interaction between group and time for Spike Accuracy

The figure has the spike accuracy scores of the experimental and control groups at the pre-test and post-test stage. The accuracy levels of spikes were similar in both groups at the pre-test stage. The experimental group scored around 10.7 and the control group scored a bit under with an average of 10.2. The error bars show that there is a similar variability between the groups at baseline. The experimental group showed a significant increase in spike accuracy at post-test with the mean of the spike accuracy increasing to around 15.6. On the other hand, the control group demonstrated minimal betterment that went up to approximately 11.0. On the whole, the accuracy of the spikes was increasing with time in both groups, although the improvement was significantly greater in the experimental group compared to the control group. The increasing discontinuity between groups of pre-test to post-test and non-parallel nature of the lines signify the presence of a group time interaction, i.e. the different change in spike accuracy over time varying between group membership.

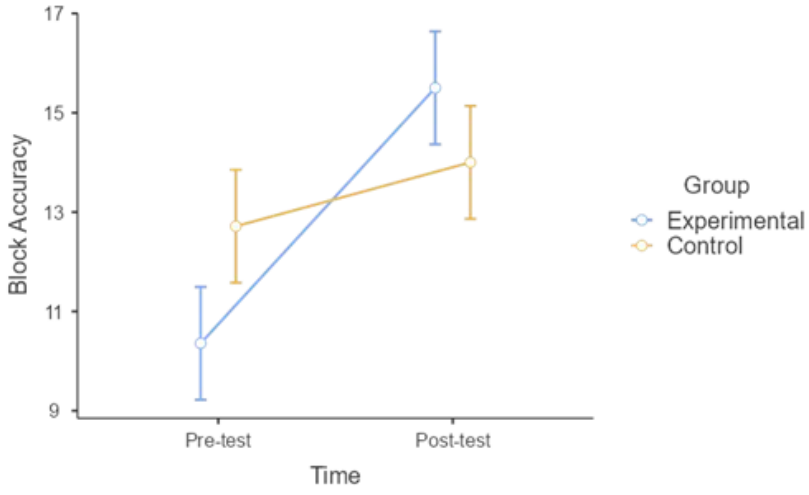


Figure 4: Interaction between group and time for Block Accuracy

The figure describes the scores of block accuracy prevalent in the experimental and control groups prior to the test and after the test. Control group was more accurate in block (about 12.7) than the experimental group (about 10.4) at pre-test. The error bars show the presence of some variability in each group but slightly larger in the control group at

baseline. By the end of the test, the two groups had improved block accuracy. The experimental group rose significantly to about 15.5, whilst the control group rose less to about 14.0. Over the time, significant gain in block accuracy was observed in the experimental group only and the control group showed a moderate gain. This is despite the fact that the control group initially scored higher than the experimental group at pre-test but at post-test, the experimental group outperformed the control group. The non-parallel lines and the variation in the ranking of the groups by the passage of time imply an interaction of the group and time, that is, the enhancement of the block accuracy was not the same in both the experimental and the control group.

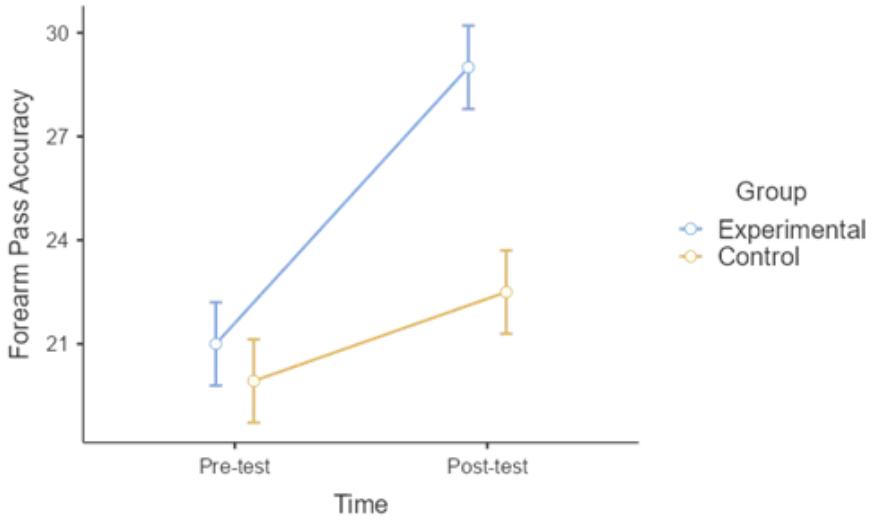


Figure 5: Interaction between group and time for Forearm Pass Accuracy

The figure shows the consequences of a teamwork intervention in volleyball-specific performance, namely, in forearm pass accuracy addressed at two time points: pre-test and post-test. The graph involves a comparison of performance of Experimental and Control Groups. The Experimental Group (the blue line) indicates the significant increase in the accuracy of the forearm passing in the post-test condition compared to the initial one, and the scores are raised within the range of about 24 to 30. On the contrary, the Control Group depicted by the yellow line reflects a slight change in accuracy improving approximately 21-23. The error bars in the graph capture the fluctuation in the data, which capture the dispersion of the scores in each group. All in all, the data indicates that the teamwork intervention was of great help to the work of the experimental group, improving the accuracy of forearm passes of executive positioning in them as compared to that of the control group, who did not get the intervention.

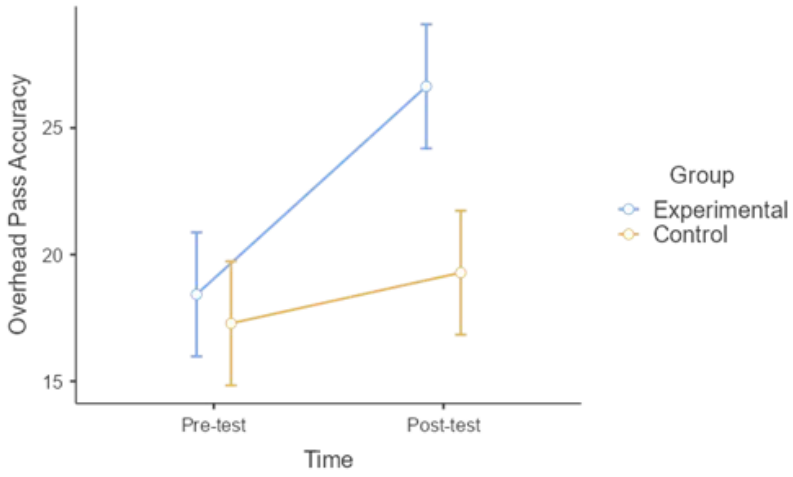


Figure 6: Interaction between group and time for Overhead Pass Accuracy

The figure represents the effect of teamwork intervention on volleyball team performance, in terms of accuracy of overhead passes. The graph is a comparison of the performance of the two groups, Experimental Group and Control Group at two different points in time pre-test and post-test. The Experimental Group in terms of the blue line demonstrates a significant increase in the accuracy of the overhead passes during the post-test compared to the pre-test, their scores have risen by approximately 20 to 26. The Control Group (yellow line) on the other hand only shows a slight increase, as it increases slightly, only about 18 to 20. Error bars on the figure denote how different the scores of the different groups are. Such findings imply that the teamwork intervention had a great impact on the accuracy of the overhead pass in the experimental group but there was little improvement in the control group.

Discussion

The results of this research prove that MMTS-2 intervention helped to achieve the positive result in the volleyball skill accuracy and serve, spike, block and passing skills. The skill of serving is strategically significant in the game of volleyball because it starts the rally and can directly award points [15]. Athletes tend to experience performance anxiety, attentional collapses and overthinking when serving. As was found in the past studies, the practice of teamwork seems to assist in the suppression of distraction and anxiety among the athletes who remain process-oriented [16, 17]. These mechanisms can be the reason why there is an increase in the accuracy of serves in the current research. One other process that is supported by teamwork training is motor learning. Serving, spiking and blocking are sophisticated motor skills which demand open-skill adaptability and closed-skill technical stability [18]. Through enhancing awareness in the present moment and exerting control over emotions, teamwork can help athletes to stabilize technical performance in order to adjust to alterations in game contexts [19]. The changes in the spike and block performance of the experimental group of the post-test values are consistent with the results of the studies that teamwork improves the executive functioning and attentional control which are vital in timing, position and decision making during play [20, 21]. The intervention was also beneficial in the passing of skills, including forearm and overhead passes. These are skills that require a fine coordination of the postures, control of the limbs and concentration. Experiments conducted previously have indicated that teamwork improves proprioceptive awareness and minimizes superfluous muscle tension which translates into superior technical performance [16, 22]. In the current research, players who received MMTS-2 were much less prone to technical errors and were more reliable in control, which can indicate that teamwork can reinforce the psychomotor basis of volleyball. The present results are in line with the recent

meta-analyses in which teamwork-based interventions have been shown to have small-to-moderate effects on sport performance and psychological functioning [23, 24]. Nevertheless, this research builds upon the existing literature by implementing MMTS-2 to quantifiable results of technical accuracy in an elite group of youth volleyball players, providing the support to the application of training concerning teamwork in scenario that can be implemented within a team sport environment.

Forearm and overhead passes were also benefited by the intervention. Such skills require a high level of accuracy in coordination of posture, control of limbs and attention. Previous research indicated that in collaboration with others, proprioceptive awareness and redundant muscle tension are improved to achieve better technical performance [16, 22]. The current research revealed that the participants who were exposed to MMTS-2 had less number of technical mistakes and more stability of control, and thus results indicated that the psychomotor basis of volleyball performance can be enhanced by teamwork. These results support previous meta-analytic studies, which claim that teamwork-based intervention yields small to moderate level of improvement in sport performance and psychological functioning [23, 24]. Nonetheless, the study builds upon previous research by using MMTS-2 to the quantifiable technical accuracy performance of elite youth volleyball players, which provides the support of the applicability of the scenario-based teamwork training in the context of the team-based sport.

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