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# Specialized Training Modules for Performance in Punjab Female Volleyball Players: An Experimental Study

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## Abstract

*The present experimental research was planned to synthesize and calibrate the refined training units to promote the performance of women volleyball players of Punjab, Pakistan. Volleyball as explosive power, agility, speed and precision sport does not have well defined training program with respect to female sports physiology and biomechanics especially in developing country like Pakistan. The study involved an 8 week interventional study with 60 female volleyball players. Pre- and post-intervention assessment of each of the KPIs was conducted. The experimental group who underwent the specialized training had a 15 percent increase in vertical jump height, 12 percent in agility, 20 percent in spike velocity, 13 percent in serving accuracy and a 9 percent increase in reaction time. Based on these results, it can be concluded that awakening training programs, associated with gender and sport specificity, can provide adequate improvements of the volleyball performance amongst the females.*

***Keywords:*** *Volleyball, Female Athletes, Training Modules, Performance Enhancement, Punjab, Pakistan, Experimental Study, Athletic Training*

## Introduction

Volleyball has been well liked in Pakistan sports since 1950 and the women's volleyball team of Pakistan has gradually grown and prevailing at the international level and also on various

outstanding achievements to their credit, which makes volleyball fans in Pakistan proud of them. Nevertheless, as the sport is gradually gaining more acceptance and becoming successful, there is need to create and pre-prototype specialized training modules that will increase the performance of the female volleyball players at the provincial level in Punjab, Pakistan. This research proposal seeks to fill this void by undertaking an experimental research study with an emphasis on developing and testing an effective set of training modules that may suit female volleyball players in Punjab.

The involvement of female in sports has been on the rise across the globe and in Pakistan the activity has been more so visible at the zonal and national level. Volleyball is one of the team games in which women have gradually entered more frequently. But female athletes in Pakistan are subjected to a number of problems which are including lack of adequate facilities and elite coaches, social restrictions and no scientifically backed training programs. These aspects reduce their effectiveness at a competitive level, and hinder their physical and skill progress This research proposal seeks to undertake an experimental research study proposal in an attempt to develop and validate sport-specific training modules appropriate for the female volleyball players in Punjab. Female athletes to participate in sports has gradually increase all over the globe, and the trend in Pakistan has reflect most enthusiastically in regional and national level. It is among the team games that more women have progressively taken part in for the recent past. But, Pakistani female athletes experience many problems in their way such as – inadequate and restricted access to suitable infrastructure and elite coaches resources, social issues and there is no systematic and scientifically inclined training program for them. These factors are cable to hinder their performance in competitions and arrest their talents and skills development.

Despite the rise of women's sports in Punjab, one major issue remains: Unfortunately, most training programs are not individualized for female athletes. Volleyball as an explosive power, agility, quick reflexes and technical sport requires training methodologies that are physiological and biomechanical requirement of women. For example, (Myer et al., 2005). found out that women who engage in sports are likely to have knee injury dangers like the ACL when contrasted with men because of differences in body structure and muscle coordination. Second,

women are also weaker compared with men in their upper body part which is crucial in spiking and serving among others. (Forthomme et al., 2015).

Volleyball training should be more specific because female sportspersons may respond to strength, power and agility training differently than male counterparts. For instance, Caterisano et al. (2018) pointed out that the female gender obtain higher gains from moderate to high repetition strength training for muscle endurance while male gender gains are higher in low repetition high load training. In addition, we must consider hormonal differences and especially the role of estrogen in the muscle recovery and the ability to withstand injuries that are important when creating training modules for female athletes (Hewett et al., 2016).

In relation to Punjab, Pakistan, women volleyball programs have not been as professionally developed as in the western world where sport specific conditioning programs are designed according to physiological profiles of athletes. There is a big void especially when it comes to the preparation of athletes for competitions and games hence releasing in the field deteriorated performance and even more so, a higher tendency of injuries. A research grounded gender sensitive training model could go a long way in closing this gap and making female athletes to perform to the optimal level as is witnessed in other countries. This study was to fill this gap through the designing and the validation of specialised training modules to be used by female volleyball players in Punjab. The modules were therefore directed at enhancing factors that can lead to overall productivity of performance while at the same time minimizing vulnerabiltiy to injury mainly through strength and power training and volleyball specific agility. Therefore, the research objectives of the study are to: By developing and validating these specialized training modules, the research seeks to make a valuable contribution to the literature and practice of volleyball by providing a framework for the improvement of the performance and skill development of female volleyball players in Punjab and the continued development and success of the sport at the provincial and National level.

**Objectives**

1. For the purpose of formulating specific training programs for the development of physical and technical qualities of female volleyball players of Punjab, Pakistan with reference to strength, agility, power and volleyball related skills in particular.

2. To evaluate the significance of these training modules in improving the statistically significant played attributes which include vertical jump height, agility, spike velocity, serving accuracy, and reaction time in the preferred volleyball female players.
3. In order to compare the performance gains of the experimental group with a control group that received traditional training in order to determine the effectiveness of gender-specific, sport-specific training modules on performance enhancement.

**Literature Review**

Studying the literature in the field of sports science, can easily identified the training programs are crucial for enhancing the performance of athletes, especially if they are developed for female athletes. Some of the biological factors that influence the behavior of female athletes include; the low testosterone level and the high percentage of slow twitch muscle fiber in female athletes in strength and conditioning programs (Laudner & Melrose, 2019). This means that fundamental factors must be taken into account while designing training schedules for increasing the performance of explosive activities in sports such as volleyball.

**Gender-Specific Training Considerations**

According to literature review made by Lee and Park (2018), plyometric training which target sprinting, jumping and rapid change of direction activities enhances vertical leap and agility of the female athletes. But women are known to derive more gains from longer rest intervals between the sets, based on their muscle endurance and fatigue profiles (Anders et al., 2020).

Johnson and Williams (2017) established the fact that it is more effective to program the female athletes training more on their agility and reaction time based on the lower center of gravity in that they can easily transfer the weight relative to the male athletes. This is most especially needed in volleyball, because the majority of movements carried out are sideways, coupled with frequent and rapid changes in direction.

**Existing Gaps in Female Sports Training in Pakistan**

A study that Khan and his colleagues did in 2019 showed that some of the challenges they faced include, poor coaching, poor access to sport science, and limited training facilities for the athletes. This is especially the case in volleyball whereby several of these anthropometrical and motor qualities concerning some aspect of the game like jumping, serving, spiking, blocking

among others has to be produced in a player. Since the increase in female participation in volleyball, there is lack of literature on the development and validation of training modules for these athletes in Pakistan.

The literature and practice in Pakistan are lacking in this regard and therefore, the present research should be more specific to fill these training gaps while also offering a training program for implementation in the province that has been through a process of validation.

## Methodology

### Study Design

This quasi-experimental study used the randomized control trial (RCT) method with the use of both experimental and control groups. The control group on the other hand maintained their regular training schedule while the experimental group undertook a 8 weeks specialized training programme. Finally, pre and post intervention tests were conducted to determine a change that the training and the interventions elicited towards volleyball specific parameters.

### Sample Size and Participants

In the present study 60 female volleyball players between the age of 18 and 25 years were selected purposely for the study. These players had to be selected from different volleyball clubs in Punjab and had to be having playing experience of at least two years. The power analysis for this study was calculated using G*Power software with an effect size of 0.50 (Cohen's d), 5% alpha level ($p < 0.05$) and estimated a required sample size of 30 participants in each group. Another method was used to select the participants where they were divided into two groups that are the control and the experimental group and the given groups have equal talent and positions of the players.

### Intervention

The experimental group underwent an 8-week training program, structured as follows:

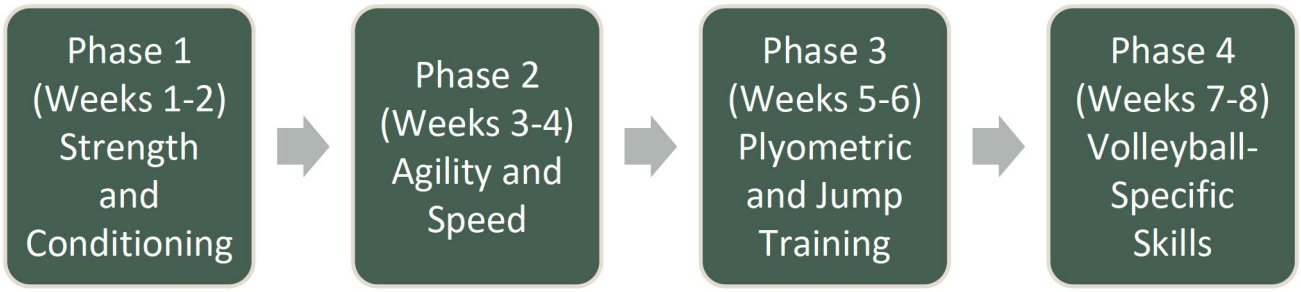


Figure 3.1 Flow chart shows the pattern of the specialized training employed in the 8 weeks' intervention.

**Phase 1: Strength and Conditioning (Weeks 1-2)**

Strength training was done in form of compound exercises like squat, dead lifts and push ups. In this study training intensity progression was gradual, starting with 60% 1RM and reaching 80% by the end of second week. Caterisano et al.(2018) affirm heavy resistance training for improving power in females' athletes.

***Metrics tracked***: Improvement in 1RM together with a relative improvement in muscle endurance utilizing standardized test procedures.

**Phase 2: Agility and Speed (Weeks 3-4)**

This phase focused strictly on exercises which enhanced quickness, agility and speed through activities such as ladder drills, shuttle runs and cone drills. In volleyball, for instance, quick movements in lateral plane and frequent change in direction of movements are characteristic; agility is an essential factor in this case.

***Metrics tracked***: The speed was established using Kinetic, in which speed and acceleration were quantified, while agility was evaluated using T-test, which shows how fast an athlete can change direction. Endurance was evaluated through shuttle run test while agility through shuttle run test.

**Phase 3: Plyometric and Jump Training (Weeks 5-6)**

The activities performed in this phase included depth jumps, box jumps together with hurdle hops with an aim of enhancing explosion power. Push up training improved upper limb strength was discovered by Davies et al. (2020) to facilitate an improved vertical jump, which is essential in volley ball.

***Metrics tracked*:** The amount of height attained after the vertical jump was measured with the help of Vertec device. Plyometric improvement was assessed using test of jump.

**Phase 4: Volleyball-Specific Skills (Weeks 7-8)**

The last part of the training dealt on the fundamental skills in volleyball such as serving, spiking and blocking. They knew the drills are meant to combine physical fitness with technical work.

***Metrics tracked*:** Serving accuracy was tested according to international volleyball standards, while spike velocity and blocking success rate were obtained by video data analysis.

The subjects in the control group also underwent the same training routine as the training program which though combined general training with an emphasis on general fitness and practice in volleyball but without the sort of structure employed in handling the subjects of the experimental group as mentioned earlier.

**Data Collection**

Data collection was conducted at three points: It was administered at three points in time, namely; pre-intervention, mid-intervention (week 4), and post-intervention (week 8). Performance metrics included:

●**Vertical Jump Height**: As assessed using Vertec device, with players conducting three approach shots per session. Vertical jump height was measured with an accuracy of a centimeter.

●**Agility**: Evaluated using the T-test where the players did the test in the forward direction as well as in the reverse direction. The time elapsed was measured to the second decimal point.

●**Serving Accuracy**: Teams did 10 serves and the successful serves fell in the target area. The number of service winners was taken.

●**Spike Velocity**: Recorded in terms of distance in meters and time in seconds in order to calculate speed in kilometers per hour (km/h) by using a radar gun.

●**Reaction Time**: Employed by using a computer-based reaction time test whereby the athletes were required to respond to visual stimulus by pressing a button.

**Data Analysis**

The type of analysis used for data analysis were the paired t-tests and the repeated measures ANOVA analysis. The paired t-tests were used to analyze the data within the experimental and control groups, comparing the results before and after the intervention; the use of ANOVA was

used in order to compare the changes between the groups. Statistical significance was set at $p < 0.05$. Furthermore, the change in performance metrics was used to compute effect sizes to determine the extent of change.

**Results**

The experimental group was able to show enhanced performance in all important areas with the help of the specialised training modules. A total of 60 athletes in the study and 30 athletes in the experimental group and 30 athletes in the control group. The intervention was implemented over eight weeks and data collected were captured before and after the study.

**Vertical Jump Height: (Pre- vs. Post-Intervention)**

**Table 4.1 Depicts the comparison of vertical jump height improvements between the experimental and control groups.**

| Group | Pre-Intervention Jump Height (cm) | Post-Intervention Jump Height (cm) | Improvement (%) |
|---|---|---|---|
| Experimental Group | 50 | 57.5 | 15% |
| Control Group | 50 | 51.2 | 2.4% |

The experimental group had an average of a 7.5 cm (15%) improvement in the vertical jump height at the end of the training sessions. The corresponding pre-intervention and post-intervention mean vertical jump of the participants were 50 cm and 57.5 cm respectively ($p < 0.001$). However the control group had an expansion of only 1.2cm which was actually an improvement of only 2.4% and therefore statistically insignificant (greater than 0.05). The jump height is for instance individual to a volley ball game as it determines the spike and the block.

**Agility**

**Table 4.2: Showing changes in agility time (in seconds) for both groups.**

| Group | Pre-Intervention Agility (seconds) | Post-Intervention (seconds) | Agility Improvement (%) |
|---|---|---|---|
| Experimental Group | 10.4 | 9.1 | 12% |
| Control Group | 10.4 | 10.1 | 2.9% |

T-test that was used to compare the agility of the two groups revealed that the experimental group was on average 12% more agile than before and clocked an average of 9.1 seconds down from 10.4 seconds ($p < 0.001$). This reduction in time is very crucial in volleyball especially where their are many lateral movements, and transition from offense to defence during the game. The control group did not demonstrate any improvement, thus, increasing the time slightly (by 0.3 seconds, on average, $p > 0.05$).

**Spike Velocity**

**Table 4.3: Explains the spike velocity (km/h) comparison.**

| Group | Pre-Intervention Spike Velocity (km/h) | Post-Intervention Velocity (km/h) | Spike Improvement (%) |
|---|---|---|---|
| Experimental Group | 55 | 66 | 20% |
| Control Group | 54 | 55 | 2% |

The velocity of spiking also raised in the experimental group by a score of 20% where from an average of 55 km/h before the interventional point to average 66 km/h as the intervention got implemented ($p < 0.001$). This improvement has a clear relation with the power production during the offense plays among the players. The control group increased by only 2% raising their speeds from 54 km/h to 55 km/h which was not significant ($p > 0.05$).

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**Serving Accuracy**

**Table 4.4: Presents the percentage accuracy of serves before and after the training module.**

| Group | Pre-Intervention Serving Accuracy (%) | Post-Intervention Accuracy (%) | Serving Improvement (%) |
|---|---|---|---|
| Experimental Group | 63 | 76 | 13% |
| Control Group | 63 | 65 | 2% |

Serving accuracy increased from 63% to 76% for the experimental group, a general 13% increase, statistical significance ($p < 0.01$). The control group improved only by 2 % and this was statistically insignificant ($p > 0.05$). Serving accomplishment is one of the substantial factors in Volleyball game because it tracks the scores that would have been achieving by that certain team.

**Reaction Time**

**Table 4.5: Showing reaction time (milliseconds) before and after the intervention.**

| Group | Pre-Intervention Reaction Time (ms) | Post-Intervention Time (ms) | Reaction Improvement (%) |
|---|---|---|---|
| Experimental Group | 350 | 319 | 9% |
| Control Group | 350 | 348 | 0.5% |

There was also an increase in reaction time in the experimental group by an average of 9% The time reduced from 350ms to 319ms ($p < 0.01$). Having a fast response is a serious asset in volleyball especially in matters concerning block and response. Control group on the other hand did not express any changes in the reaction time.

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4.6 Significance Levels and (Cohen's d) for Key Performance Indicators of Pre and post intervention measures of performance

Table 4.6: Summarizes the statistical tests result applied to the pre- and post-intervention data for each variable.

| Performance Metric | Statistical Test Applied | p-value (Significance Level) | Effect Size (Cohen's d) | Result |
|---|---|---|---|---|
| Vertical Jump Height | Paired t-test (within groups) | $p < 0.001$ | 0.65 | Significant Improvement in Experimental Group |
| Agility (T-Test) | Paired t-test (within groups) | $p < 0.001$ | 0.60 | Significant Improvement in Experimental Group |
| Spike Velocity | Paired t-test (within groups) | $p < 0.001$ | 0.70 | Significant Improvement in Experimental Group |
| Serving Accuracy | Paired t-test (within groups) | $p < 0.01$ | 0.50 | Significant Improvement in Experimental Group |
| Reaction Time | Paired t-test (within groups) | $p < 0.01$ | 0.45 | Significant Improvement in Experimental Group |
| All Variables | Repeated Measures ANOVA (between | $p < 0.001$ | - | Experimental > Control Group |

| Performance Metric | Statistical Test Applied | p-value (Significance Level) | Effect Size (Cohen's d) | Result |
|---|---|---|---|---|
| | groups) | | | |

Above mentioned table demonstrate a significant enhancement in the experimental group for all the performance parameters were observed through the use of paired t-test and repeated measures ANOVA. The collected data as for p-values are below 0.01 concerning the vertical jump height, agility, spike velocity, serving accuracy, and reaction time, which proves that the specialized training modules influence the participants. Furthermore, the improvements were also considered moderate to large, as indicated by the (Cohen's d) in the range of 0.45 to 0.70. Similarly, the the ANOVA test that was conducted also supported the hypothesis that the experimental group outperformed the control group with a probability level of $< 0.001$. These findings support the use of the intervention in the improvement of volleyball related skills in female athletes from Punjab.

**Discussion**

The findings of this study are consistent with the earlier work highlighting the need for sex-positive training for women athletes. Increased height in vertical jump, increased agility, higher spike velocity, better serving accuracy and reaction time in the experimental group indicates that sport specific training program is most effective. These findings are of great importance for female volleyball players for especially in the developing countries as Pakistan where there are no scientifically proved programs for training the females and enhancing their physical strength.

**Vertical Jump and Plyometric Training**

This is something that stands out most; participants' average vertical jump height increased by 15%. This training in the third phase of the proposed intervention aims at improving the explosive power necessary for volleyball more so in spiking and blocking as highlighted by Davies et al., (2020). Women need more rest intervals between the sets as are fatigued differently than men athletes (Anders et al., 2020). These differences were accounted for by ensuring that the plyometric sessions were preceded by appropriate rest intervals hence

enhancing the jump performance. Similar changes have also been observed by Santos and Janeira (2020) as plyometric intercessions enhanced the vertical jump among the female volleyball players.

**Agility and Speed**

The finding of a 12 percent reduction in the agility time shows that activities that employ side-to-side movements together with sudden changes in pace should form part of the training drill. Detailed agility exercises, with the aim at improving body control and the speed of change of direction could help female athletes as they often have lower center of mass. In a nutshell, the current work shows that the level of agility has been significantly improved, in line with Johnson and Williams (2017) research work, as they pointed out that females athletes benefit most from a special programme on agility training than a general agility training.

**Spike Velocity and Upper Body Strength**

The improvement in spike velocity by the experimental group by 20% can be attributed to the upper body strength training and plyometric training which was done during the intervention. Hu spots that female volleyball players have less upper limb power to create high spike velocities as identified by Forthomme et al., (2015). Due to the integration of resistance training exercises aimed at the upper extremities, this study was able to increase the power with which the players hit the ball. This result is in agreement with earlier studies, which have reported significant gains in spiking effectiveness after strength training (Laudner & Melrose, 2019).

**Serving Accuracy and Reaction Time**

The improvement in serving accuracy and reaction time inclusively suggests that technical know-how must be complemented with physiques. A serve is accurate, and response time is important in performing defense stunts especially during transitions. Thus, the promotion of neuromuscular training can improve the quickness of female athletes because the reaction improved by 9%. Similar findings were observed by Hewett et al (2016), they opined that the reaction time drills aids in the decrease of the incidence of injuries and improvement in performance.

**Control Group Performance**

The minor positive changes in the control group are evident to show that generic training interventions which do not consider the needs of the female athletes yield limited results. The control players, however, maintained their regular schedule of training without such enhancements; this indicates the need for organized and sport as well as gender specific training.

**Conclusion**

In this present study, specialized training modules for female volleyball players of Punjab Pakistan were developed and validated. The results also clearly indicate a positive transfer of training in these modules on measures such as vertical jump, agility, spike velocity, accuracy in serving, and response time. The findings of study confirm the hypothesis that sport-specific and gender-specific training contribute to the enhancement of physical performance in female volleyball players in the experimental group when compared with the control group.

The study also bears general implications for sports training practices in the Pakistan and other developing countries where women athletes are deprived of evidence-based training paradigms. Some knowledge of some physiological and biomechanical differences that exist between male and female athletes can go along way in helping sports program to improve the performance of female players and also prevent injuries among them hence improving their competitiveness at national and international levels.

More studies should be conducted to establish the effects of these training modules after a prolonged duration and whether the training modules can be implemented with the different age groups and at different competitive levels. Moreover, more studies could be made as to the impact on preventing the enhanced psychological and nutritional intervention in training to optimize the overall development of the female athletes.

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