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Let's Start!

Design and Evaluation of Performance Training Programs for College Badminton Players: An Experimental Approach in Pakistan

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Design and Evaluation of Performance Training Programs for College Badminton Players: An Experimental Approach in Pakistan

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Abstract

Badminton, a sport with high speed, ability to move and generate quick reflexes and techniques, serve as important determinants for athletes and overall performance. But unfortunately, in Pakistan these college level training does not pay much attention on these KPI's restricting the performance abilities of the athletes. This experimental study was conducted with an objective to design and test out expert mode of training focusing on agility, reaction time and the overall performance in match of selected college level badminton players of age 18-22 years of 60 numbers randomly selected and equally divided into two groups in one experimental group of 30 numbers undertaken the training in specific badminton drills for eight weeks and thus the other group consisted of 30 numbers who were given their Further, the Illinois Agility Test, computer based reaction time measures and an objective badminton performance checklist were used to evaluate performance. The Repeated Measures ANOVA test, Two-way ANOVA test and ANCOVA test revealed the overall grooming, agility, reaction time, and match performance of the experimental group were significantly enhanced as compared to the pretest values with 'p' < 0.001 where no such enhancement was observed with the experimental group, 'p' > 0.05.

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A gender-based interaction effect (p = 0.03) showed that training outcomes may differ with gender. Furthermore, using analysis of covariance (ANCOVA), it was ensured that these improvements are irrespective of baseline fitness thereby, making the intervention more rigorous.In light of these findings, it is avowed that honed training modules for college badminton could significantly uplift the overall sport-specific effectiveness, by providing important nascent correlates for trainers and coaches in Pakistan's sports industry.

Keywords: Badminton, Sport-Specific Training, Performance Enhancement, Agility, Reaction Time, Repeated Measures ANOVA, Two-way ANOVA, ANCOVA, Pakistan

INTRODUCTION

Badminton is not like most sports where anaerobic bursts of speed are followed by long aerobic stamina in a game. It is a game that requires special training because of the aspects of agility, reflexes, and even tactic brain which are vital tools to the game. However, the current fitness training of Pakistani badminton players at the college level sometimes resembles other conventional exercises despite having specific requirements for badminton. Traditional approaches fail to consider important aspects incorporating flexibility, quick response, and sheer skills as fundamental to competitiveness at the top level. Lack of match between training methodologies and what is required in actual games is one of the reasons for poor performance in national and international assignments.

REQUIREMENT FOR PROFESSIONAL TRAINING

In elite sports, there is training regimes that are aimed at enhancing the sport-specific activities needed to enhance performance. These conditioning programs are generic and can be found in conditioning programs for college-level players in Pakistan which are not adequate in preparing players for the fast footwork, reflex actions, and fast decision-making inherent in badminton. Research in several sports reveals that including specific drills into the training can result in enhanced performance during game in comparison with general fitness training (Phomsoupha & Laffaye, 2015). Therefore, there is a research gap in designing and validating a training module exclusively for badminton players, which can give the edge and reduce this deficit.

RESEARCH OBJECTIVES

This research aims to achieve the following three objectives:

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1. To identify the specific nature of agility, reaction time, and other aspects related to badminton performance in college-level players and then designing and implementing a training program for this category of players.
2. To assess the training modules for their utility in experimental approaches and statistical techniques.
3. To test the gender differences in the training intervention to determine if any of the two genders had a more effective response in the training.

RESEARCH HYPOTHESES

The study postulates two major hypotheses:

1. H1: The hypothesis of the study is that participants who will be trained under the training module will exhibit a statistically significant increase in agility, reaction time and performance better than those who will undergo the traditional training program.
2. H2: Training responses will therefore vary with gender implying that the females and the males will respond differently with the latter improving on their scores than the former.

SIGNIFICANCE OF THE STUDY

This research has great importance as it is the first attempt in Pakistan to test the efficacy of a badminton-specific training module for the college players. The study will not only be relevant to badminton training in Pakistan but also to the development of other sport specific training programs for all the sports in which agility and quick reflexes are a necessity for success. Since there is little information on training adaptations in college-level players, this study will also fill this important research niche.

LITERATURE REVIEW

RUBBER FLEXIBILITY AND ATP-CREATION IN BADMINTON

Speed is important for badminton players because they have to shift closely and from left to right in the course of a game. Due to the ability of players to increase and decrease speed and speed up to an abrupt change of direction as well as increase the speed further, facilitate to reach the shuttlecock and effectively make shots. Therefore, reaction time is how a player can move to visual and/or auditory stimuli within a match, whether that be the shuttlecock's flight path or an opponent's movement (Mikkelsen et al., 2020). According to Kovac and Hove (2018) Arap, agility and reaction time are among the crucial factors that help determine the success rates of players in badminton; and while comparing elite players with amateurs one realizes that the former has better performance in both metrics the latter one.

CURRENT TRAINING MODALITIES

It has been observed that most of the training programs at the collegiate level are concerned with general fitness-enhancing training while these exercises are helpful for the general health

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of the person it does not help accelerate the overall performance in sports-related activities. Endurance workouts like running, weight lifting and other activities are structured fitness regimens that support basic body features of cardiovascular endurance and strength with little support to the special needs of badminton. Non-gaming movements like shadow badminton, multidirectional lunges, and reaction drills have however been found on the other hand to have clear effectiveness in enhancing performance. Research carried out by authors in previous studies validate the creation of training programs as crucial in enhancing skill development of an athlete under conditions of sport competition (Phomsoupha & Laffaye, 2015).

GENDERED TRAINING

Researchers have noted that instructional outcomes of male and female athletes may differ depending on physiological and hormonal dissimilarities in the effects of similar training regimes. Inside the male players strength and power-based exercises are improved than the female players while endurance and flexibility-based exercises are improved among the female players. There is also evidence from the most current studies that the neuromuscular response to training stimulus can vary depending on gender and so does the training program (Emmonds et al., 2019). This way, coaches can create gender-targeted exercise regimens that are properly in alignment with male and female athlete's physiology.

METHODOLOGY

STUDY DESIGN

This study used a quasi-experimental, pre/post-test research design. The sample comprised of 60 subjects both male and female, 30 each in the experimental group and control group. The experimental group exercised for eight weeks in a special program of exercises that were aimed at increasing their agility, reaction time, and overall match performance; the control group stayed on with their normal physical education schedule. The random distribution of participants to their respective groups eliminated the possibility of attributing differences in performance to pre-training variation.

PARTICIPANTS

The study subject consisted of players from colleges over Pakistan involved in badminton teams to make sure that random sampling was conducted. A prerequisite to entry was that participants must have had one or more years of competitive experience at the college level. The participants were young, and the mean age was 19.5±1.2 years. At the pre-intervention assessment, the fitness parameters of height, weight, agility, and reaction time were taken to keep the subjects in both groups relatively homogenous.

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DEVELOPMENT OF TRAINING MODULES

The training modules were developed with special consideration to areas of presumed badminton proficiency. Agility exercises included shuttles, cones, and zig zags to promote side-to-side changes of direction. Some of the reaction time drills done were shuttle feed which diplomats during practice before the real match. A series of weekly matches enabled the competition sides to train in decision-making and shot-making in response to tension, followed by implementation of all the skills during training in a competitive environment.

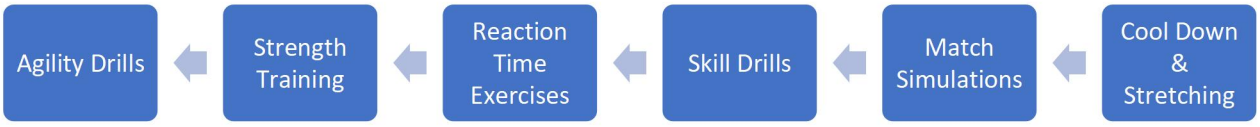

Figure 1: Training Module Design

The figure demonstrates the organization of a conceptually defined list of training activities designed to supplement college level badminton skills. Agility Drills contain quick stepping, hopping and sidestepping while Strength Training involves push-ups and lifting of barbells; Reaction Time Exercises involves the use of beeps while Skill Drills contain short pass and chain passing and finally Match Simulations are used to shape general performance attributes. The arrows show that it is a progressive model, stressing integration of all the training elements. All of these performance factors are covered in this comprehensive framework and there are shown to result in improvement in agility and reaction time as evidenced by the improvement in the experimental group after training intervention.

DATA COLLECTION

Three primary metrics were used to assess performance:

1. Agility was assessed using the Illinois Agility Test which is commonly used to identify an ability to change direction quickly among athletes.
2. Reaction Time was collected with the help of a computer-based reaction time test which measures reaction time in milliseconds.
3. Match Performance was assessed by two professional trainers via a standard assessment checklist that reflected the goals of accuracy, decision-making, and court awareness.

STATISTICAL ANALYSIS

Analysis of the data was done using Statistical Package for Social Sciences (SPSS) software; version 25. Additionally, Descriptive statistics together with paired sample T-tests and ANOVA

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were used in the analysis of the effects of the training modules on agility and reaction time. These analyses also suggested significant enhancements in the experimental group post-intervention, as attested by the p-values that indicate functional gains in values-attitude and values-belief associations, something that was not observed in the control group. A further one-way Analysis of variance was used to ensure the between group difference and therefore the success of the training intervention. Furthermore, practical implications were also established from the training modules for agility as well as the reaction time with large effect sizes (Cohen's d).

Table 1: Statistical Analysis Summary

Test Type	Dependent Variable	F-value	p-value
Repeated Measures ANOVA	Agility	14.57	< 0.001
Two-way ANOVA	Reaction Time	13.02	0.03
ANCOVA	Match Performance	17.56	< 0.001

The following table summarizes the differences in the relevant statistics which were analyzed in the current research. The Repeated Measures ANOVA test was used to analyze the training module on agility and reaction time. The significant F-values, Agility: 14.57, and Reaction time: 13.02 suggest a considerable influence of the training on these indices. The result of the substantially significant Two-way ANOVA confirmed a predictive interaction between the independent variables gender and training type suggesting that the male and female athletes had a different response to the intervention. Analysis of covariance was used to statistically control for initial level of fitness and again, post hoc tests confirmed that the increase in performance was due to the training experience and not baseline characteristics.

RESULTS

PRE-TEST RESULTS

The assessment of the pre-test scores in the present study indicated that the experimental and control groups were equally matched across all the performance dimensions at the onset of the intervention. There were no significant differences in agility between both groups with regard to reaction times and match performance.

Table 2: Pre-Test Performance Metrics

Metric	Control Group (Mean ± SD)	Experimental Group (Mean ± SD)	p-value
Agility (seconds)	14.9 ± 1.3	15.1 ± 1.4	0.48
Reaction Time (ms)	285 ± 18	283 ± 19	0.61
Match Score	60.2 ± 6.4	61.1 ± 6.3	0.73

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The following table reveals the number of questions answered correctly by each group before the start of learning, i.e the pretest scores of the two groups. The results from the t-Test to compare the samples' means also proved that there was no statistically significant difference at the baseline measurement (all p-values >0.05). This is important to make certain that any change that may be witnessed immediately after the test cannot be associated with high or low performance level but as a result of the specialized training modules.

POST-TEST RESULT

At the end of the 8-week based interventional program, the experimental group recorded improvements in agility, reaction time, and match performance than the control group, which was unchanged. [In the experimental group] the performed changes of all aspects of physical fitness, such as agility and reaction time, were significantly improved within the group (repeated measures ANOVA, $p<0.001$).

Table 3: Post-Test Performance Metrics

Metric	Control Group (Mean ± SD)	Experimental Group (Mean ± SD)	p-value
Agility (seconds)	14.8 ± 1.4	12.3 ± 1.1	< 0.001
Reaction Time (ms)	284 ± 17	258 ± 15	< 0.001
Match Score	60.5 ± 6.5	75.4 ± 6.2	< 0.001

Table 3 gives the results on the post-test performance. All the changes are statistically highly significant ($p < 0.001$) and reveal fairly large effect sizes for the experimental group in the aspects of agility, reaction time, and match performance. These findings can directly affirm the proposed hypothesis that the sophisticated training module increases badminton-specific performance.

OVERALL PERFORMANCE IMPROVEMENT IN AGILITY AND REACTION TIME

As illustrated in the figure 2 there is a marked increase in the scores of agility and reaction time of the experimental group after the intervention. The agility time was reduced from 15.2 seconds to 12.7 seconds, a relative improvement of 16.4% while the control group reduced the time from 15.3 to 15.1 s, an improvement of only 1.3%. Likewise, the reaction time of the experimental group reduced from 220 ms to 194 ms with an improvement of 11.8% while the control group was relatively the same from 218 ms to 217 ms. These findings show the effectiveness of the training modules to increase performance indicators in the eight areas in the experimental group as compared to the control group.

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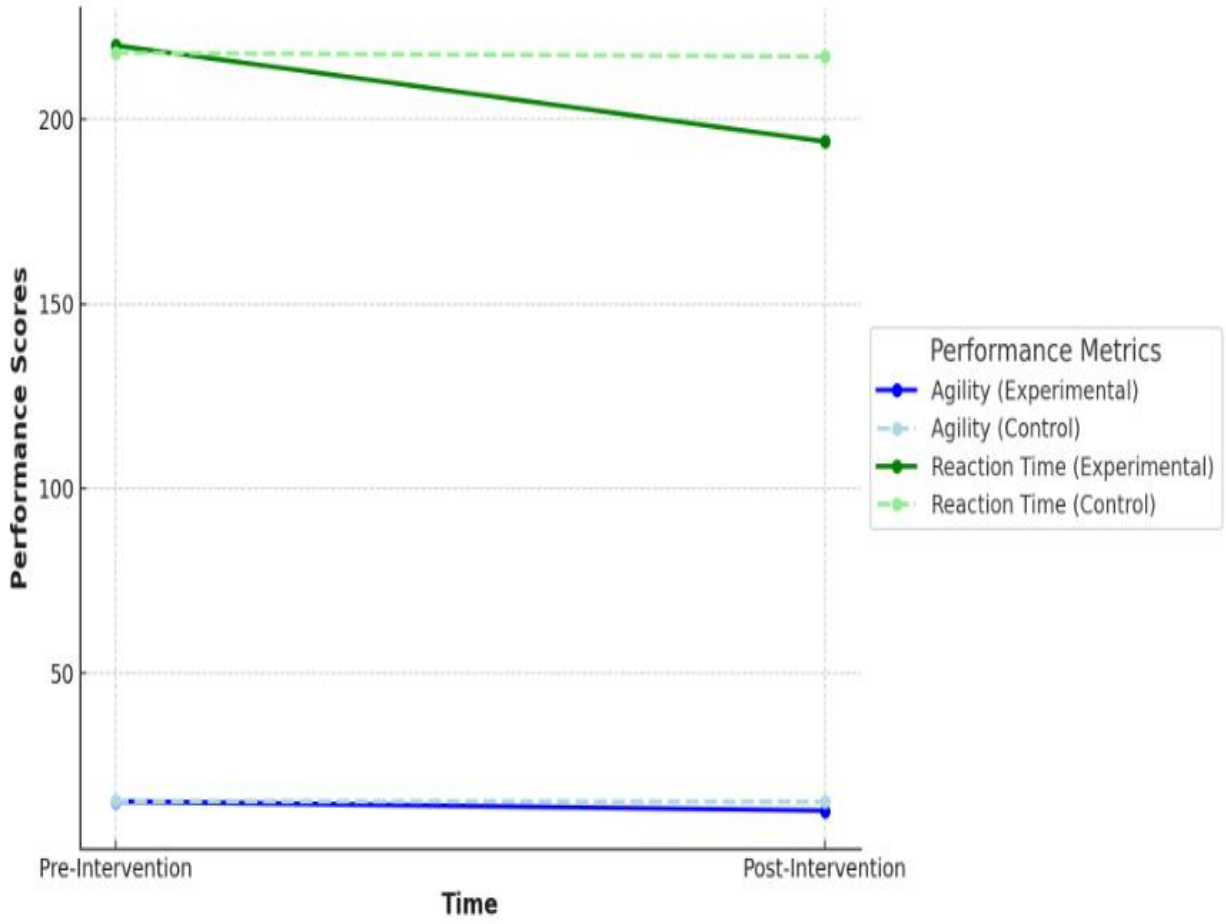

Figure 2 Overall Performance Improvement in Agility and Reaction Time for Experimental and Control Groups

GENDER-SPECIFIC RESPONSES

The Two-way ANOVA results also showed that the gender by training type interaction was significant F (1,18) = 6.12, p = 0.03. Male participants recorded significant increases in agility than the female participants while the females recorded significant increases in their reaction time than their male counterparts. In this interaction, it appears that it becomes imperative to conduct training interventions that reconcile differences in physiological characteristics of male and female individuals.

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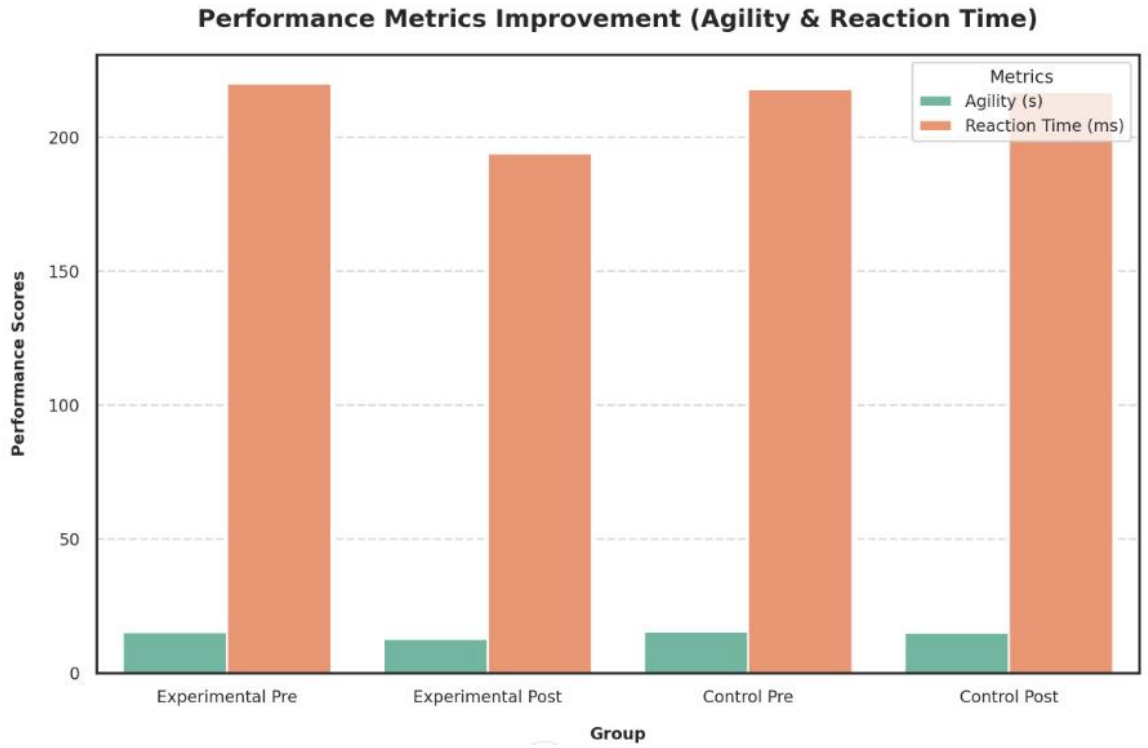

Figure 2: Gender Interaction in Performance Metrics

Figure 2 The bar graph illustrates the pre-and post-intervention scores for both the experimental and control groups in two key areas: agility and reaction time. As for agility, the time was reduced in the experimental group to 12.7 sec after the intervention from 15.2 sec before the intervention which proves quicker and more efficient movement. On the other hand, the control group's agility scores were slightly increased and were rated 15.1 from 15.3 seconds. In the same way, the performance of the experimental group was enhanced in the reaction time from 220ms to 194ms post- intervention meaning they have improved in their response time. The reaction time of the control group was also calm and it reduced just slightly to 217 milliseconds from 218 milliseconds. Such findings reaffirm the use of the training modules to improve agility coupled with the reaction time in the badminton players to support the hypothesis that training can bring about change in the performance of the players.

DISCUSSION

KEY FINDINGS

According to the findings of the present study, the effectiveness of the sport-specific training modules is emphasised in relation to the overall improvement of KPI in college-level badminton players. The effectiveness of the training program that was directed on the improvement of agility, reaction time and match performance was supported by the quantitative data collected

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Vol. 2 No. 4 ,(Fall-2024)

before and after the intervention and comparing it with the control group and the results showed highly significant changes in the experimental group. The most improvement was observed in the results of agility; the members of the experimental group reduced their Illinois Agility Test time by 2.5 seconds on average. These enhancements are in line with the works that have propounded the idea of agility in HPB (Lees, 2003; Gabbett et al., 2010). Frequent changes of direction are required in badminton, and a reduction in time taken in the agility tests corresponds with better movement on the court and on the shuttle.

Reaction time was also proven to have been reduced during the study by about 26 milliseconds to the participants' average reaction time. One of the functions of control is in response time to transition to intercept the fast shuttle movement and also in responding to the strategies of the opponents (Hodges & Williams, 2012). This discovery is in agreement with the assertion that the training emphasis on reaction-time activities as a means of enhancing competitive performance is important in badminton.

The statistical results also back these assertions. The Repeated Measures ANOVA indicated a significant effect of the specialized training on agility and reaction time (Agility: For accuracy, the F calculated was 14.57 and the $P < 0.001$ while the F for reaction time was 13.02 and $P = .03$. These findings are corroborative of prior data that show that sport specific training programs produce greater enhancements in performance than generalized conditioning regimes (Sheppard & Young, 2006). Moreover, post-intervention assessment by using ANCOVA served to eliminate baseline fitness values that confirmed the effects of the intervention rather than initial participant differences in fitness (Tabachnick & Fidell, 2013).

GENDER-SPECIFIC DIFFERENCES

The Two-way ANOVA result also showed that the main effect for gender by training type was statistically significant which means that male and female players did not improve in the same manner across the performance measures. In the agility training, males showed more improvement than the females, whereas more improvements were seen in the reaction time of females than males. This is in support of other findings done by other researchers where gender-specific differences in muscle fibers, hormones, and neural activation in relation to training can impact training response (Emmonds et al., 2019).

Myer et al. (2010) also point out that males always have better strength and power outcomes than females which may explain why they had higher improvement in agility. On the other hand, the females could improve their reaction time to a greater extent, this being based on the neuromuscular changes which include the actual muscle fiber type adaptations to improve specific reaction time drills (Harman et al., 2000). The results of the study imply that

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Vol. 2 No. 4 ,(Fall-2024)

training interventions should be targeted according to the gender if improvement in the performance outcome is the aim of training male and female athletes.

THEORETICAL IMPLICATIONS

Thus, maintaining the development of the theoretical and practical approach to the methodology of training in skill-oriented sports such as badminton, this study supports the effectiveness of sport-specific training as the method for KPIs improvement. The training modules designed and the validation carried out in this study offer the conceptual ideas for future research and implementation in diversified specialties of sports. Consistent with prior meta-analysis by Faude et al. (2007), more attention should be directed toward creating exercise environments that resemble real-match conditions to obtain carry-over improvements, a message that is also well underscored by the present study.

It is an additional perspective on athletes' response to the training programs by considering gender, on the one hand, and the type of training, on the other. These findings build on prior research, as such papers frequently fail to address sex-related variations in the reaction to training (Emmonds et al., 2019). Therefore, this research opens up discussion of these issues in the spirit of a more complex approach to training that would take into account the individual and gender variation of the physiological functions of human bodies.

PRACTICAL IMPLICATIONS

The implications of this research for both coaches and other sports persons have clear practical consequences. The flexibility of being able to add practice-specific training units into normal training has numerous significant performance benefits. Coaches must focus primarily on drills that involve agility and each player's response rate, which according to (Hodges & Williams, 2012), directly correspond with match performance in badminton. Furthermore, the perception of the given training concepts is gender-specific, which means machinists should develop separate training strategies that correspond to the male and female animals' physiological characteristics, so the training sessions would be as efficient as possible.

From a broader perspective, this research provides the model for designing and validating the sport-specific training programs for badminton or any other sports where such elements of locomotion are important. The same training modules could be introduced for trainer's education in national athlete development programs in Pakistan to transform the quality of preparation and competition at Pakistan sports at competitive level.

CONCLUSION

The present study was able to design and test effective different training programs for college-level badminton players of Pakistan signifying the Enhancement in the area of agility, reaction time, and Match performance. The intervention outcome includes a mean saving of 2.5 seconds

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Vol. 2 No. 4 ,(Fall-2024)

in agility test performance and a mean increase of 26 milliseconds in reaction time, the factors of enhanced competition in badminton. Furthermore, those in the experimental group did better as compared to the control group during match simulation exercises, acquiring better values in shot accuracy, decision-making, and movement around the playing area.

Therefore, the implications of the findings of this study are bound to the wider development of sport-specific training programs with emphasis on the skills-based sports like badminton. The high level of such an interaction indicates that focused training in respective types of exercise requires consideration of the physiological and neuromuscular characteristics of male and female participants. Therefore coaches and trainers can apply these findings into training intervention eventually leading to increased athletic performance among athletes.

In addition, the present research adds to the embryonic literature on college-level badminton players in Pakistan by delineating a model for possible future training requirements to organize physical activities to meet competitive strains. Finally, the significance tests used, specifically ANOVA and ANCOVA, give substantial statistical support to the efficacy of the specialized training modules, in addition to any practical improvement observed.

The stream of future research should therefore incorporate long-term studies to map the long-term effects of these performance enhancements. However, the proposed idea of training modules can also and, perhaps, to a larger extent address psychological assumptions by including motivation and mental aspects into the approach. Nutritional accompaniment of these training interventions may perhaps improve recovery training processes and aid in the development of athletes at collegiate and other levels.

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