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Research Article

The effect of high-intensity interval training on fatigue index among university-level female basketball players in Srilanka

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ABSTRACT

Basketball is a fast-paced, challenging team game that places an athlete in repetitive sprinting, jumping, directional change, and anaerobic efforts with brief periods of rest. The present research aims to explore the impact of High Intensity Interval Training (HIIT) on the fatigue index (FI) among high-level female basketball players in Sri Lanka. The 20 athletes were assigned to experimental and control groups (CGs) with a pre- and post-test CG design, with the former having 8 weeks of HIIT program on top of regular workouts. FI was determined through the Running-based Anaerobic Sprint Test before and after the experiment period. Collected data were analyzed by using one-way analysis of variance. The result of the study showed that the FI decreased considerably in the experimental group ($P < 0.001$) and it did not vary significantly in the CG. The results indicate that HIIT is effective in increasing fatigue resistance, endurance and recovery ability that aid in improved athletic performance. This study will offer empirical data that upholds the fact that HIIT should be integrated into the conditioning programs of female basketball players in Sri Lanka, with the aim that it can be used to maximize performance and minimize fatigue-related injuries in female athletes.

Keywords: Fatigue index, Female basketball players, Heart rate recovery, High intensity interval training, Running-based anaerobic sprint test

INTRODUCTION

Basketball is a fast-paced, intermittent quality imposes immense pressures on both aerobic and anaerobic energy systems, and resistance to fatigue is a very important factor of performance, especially in the case of a female basketball player. Fatigue has been cited as one of the factors that decreases speed, agility, accuracy in shooting, and overall efficiency in the game (Wiewelhove *et al*., 2015). Consequently, proper conditioning methods, including High Intensity Interval Training (HIIT), are important to sustain optimum physical performance and reduce fatigue.

HIIT is an exercise mode where short and intense movements are repeated and an interval of short rest intervals. It has arisen as one of the most effective training sessions that can be effective in improving aerobic and anaerobic capacities in a small period of time (Stankovic *et al*., 2023). Research has also found that HIIT had the ability to enhance several critical measures of physical performance, such as maximal oxygen uptake (VO2max), repeated sprint ability (RSA), agility, and explosive strength in team sport female athletes (Capric *et al*., 2025). HIIT sessions conducted in basketball specific settings have been demonstrated to have a great effect on endurance and sprint performance without causing any decrease in sport specific skills levels (Aschendorf *et al*., 2018).

Fatigue accrual during the game is especially significant among female basketball players as the body and hormonal processes that affect energy metabolism and recovery, are more significant (Capric *et al*., 2025). The fatigue index (FI), as one of the performance indicators that is calculated based on repetitive sprint or anaerobic test, is an effective tool used to measure the resistance of the players to fatigue and their ability to maintain power output. HIIT, when effectively used, can lower the FI through metabolic efficiency and recovery system between high-intensity bouts (Sanchez-Sanchez *et al*., 2018). Nevertheless, little has been done to investigate the

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impact of HIIT on FI in female university level basketball players (particularly in South Asian settings).

There is a lack of research on the conditioning of female athletes in Sri Lanka, but the demand to learn more about their motivation, training practices, and physiological characteristics is obvious (Nadeeshani and Perera, 2025; Kariyawasam *et al*., 2019). Female involvement in competitive sports is determined by culture and institutional factors as well (de Soysa *et al*., 2020). Although organized university sporting programs have led to the existence of evidenced-based training interventions, especially among female basketball players, there is a dearth of evidenced based training interventions. Thus, the proposed study will address the gap that exists by seeking to explore the effects of HIIT on FI in female basketball players who play at university level in Sri Lanka. This study in particular aims at evaluating the potential to create meaningful gains in fatigue resistance studies on as a result of HIIT and consequently improve athletic performance. The study aims to offer empirical data of the use of HIIT in university basketball training programs by comparing the pre- and post-intervention FIs of players in HIIT and those in the regular training programs. Moreover, it also adds to the literature of sports science in the area, as it places the international results in the context of the Sri Lankan sport arena. It is through this that the research hopes to inform coaches, trainers and policymakers as to how to maximize the performance of female athletics through scientifically proven conditioning.

HIIT has gained a niche in modern sports conditioning, in particular in sports that entail repetitive high-intensity activities, such as basketball. The literature indicates that HIIT leads to the improvement of aerobic and anaerobic performance capacities as well as the effect of the physiological determinants of fatigue (Stankovic *et al*., 2023). This review involves an international and a Sri Lankan study to put the results into perspective regarding the effects of HIIT on fatigue, performance, and recovery in female basketball players.

Physiological Requirements of Basketball and Fatigue Mechanisms

Basketball is a discontinuous game that requires constant interchangeability between aerobic stamina and anaerobic power. The athletes often resort to sprinting, jumping, and change in direction, which is followed by brief rest periods, which result in progressive muscular fatigue (Aschendorf *et al*., 2018). High-intensity play increases the level of lactate accumulation, energy depletion, and neuromuscular fatigue in the body, all of which lead to decreased performance capacity. Wiewelhove *et al*. (2015) state that HIIT causes both functional overload and temporary fatigue, but when appropriately handled, results in the best adaptations in muscle recovery and energy metabolism. In their results, they emphasized that RSA and neuromuscular functional performance suffers only temporarily following intense HIIT microcycles after which it returns with a high degree of recovery. These physiological processes highlight the bi polarity of fatigue, on the one hand it is a restraining force and on the other hand is an adaptive stimulating factor.

Effects of HIIT on Aerobic and Anaerobic Demands

Some studies have indicated that HIIT has a positive effect on aerobic and anaerobic performance indicators of team sport female athletes. A systematic review by Stankovic *et al*. (2023) has demonstrated that HIIT programs positively affected maximal oxygen uptake (VO2max), agility, and RSA in female athletes in various sports. On the same note, Capric *et al*. (2025) verified that HIIT results in a regular enhancement of aerobic and anaerobic performance in female basketball players irrespective of their competitive and training stage. According to Aschendorf *et al*. (2018), basketball-specific HIIT programs had a significant positive impact on aerobic capacity (26.5) and sprint performance among youth female basketball players, and therefore, HIIT programs based on regular training result in meaningful physiological improvements. The results indicate that effective HIIT programs can simulate game like intensity, which enhances endurance and explosive strength, without causing training boredom.

HIIT and FI in Female Athletes

The FI is a measure of the deterioration in performance during repeated High Intensity exercises, which is a significant measure of anaerobic endurance and efficiency of recovery. Fatigue in female athletes is usually also affected by hormonal changes, muscle fiber structure, and a decreased rate of phosphocreatine resynthesis in comparison to men (Stankovic *et al*., 2023). HIIT training is especially useful in enhancing fatigue resistance through increased oxidative enzyme activity, buffering ability, and efficiency of energy use (Sanchez-Sanchez *et al*., 2018). Sanchez-Sanchez *et al*. (2018) compared the outcomes of various HIIT protocols one and three changes of direction on young female basketball players. Their results showed that those sessions that included several changes of direction had more significant agility and RSA improvements, which meant a reduced FI. These findings imply using sport specific HIIT designs can increase the capacity of players to maintain performance through time without marked fall.

HIIT, Fatigue, and Recovery Monitoring

One of the most important issues in sports performance is fatigue management. Wiewelhove *et al*. (2015) pointed out that successful HIIT should strike a balance between training load and recovery because too much load will result in overtraining. They showed that the biochemical indicators, such as creatine kinase and delayed onset muscle soreness, are increased by HIIT and recover to baseline within 72 h, which indicates the processes of adaptive recovery. The implication of such findings is that HIIT causes short term fatigue that can be

strategically used to increase long term resilience. In addition, Capric *et al*. (2025) emphasized that correctly periodized HIIT interventions are helpful to ensure female basketball players, but it is possible to adjust them to different periods of competition and pre-season to maximize performance and restoration. Addition of rest periods and observing the subjective level of fatigue are important in ensuring that risk of injury is minimized and maximizing the physiological benefits.

Female-specific Responses to HIIT

Hormonal and metabolic differences between males and females make the physiological reactions of female athletes against HIIT different. According to Stankovic *et al*. (2023), female athletes can accumulate fatigue more but also demonstrate more adaptability to acute loads with high intensity than to endurance training. Capric *et al*. (2025) also highlighted that HIIT protocols need to be conscious of hormonal changes, including changes in the menstrual cycle, because they may affect recovery and energy expenditure. There is limited research on femaleathletic conditioning in Sri Lanka. Nadeeshani and Perera (2025), however, delved into the motivational and psychological aspects of female college athletes, where the systematic goal orientation was critical in performance improvement. This goes together with the observations that the physiological conditioning is complemented by mental preparedness in the suppression of fatigue perceptions.

Sri Lankan Context: Female Athletes and Training Gaps

There is poor research in the areas of sports conditioning on the players of Sri Lanka, and specifically, women. A comparison of anthropometric and physiological profiles of national basketball and football players was made in the studies by Kariyawasam *et al*. (2019) and Ariyasinghe *et al*. (2019), and it was found that, in most cases, basketball players have been found to have greater explosive strength, running speed, and balance. Nevertheless, the structured HIIT program was hardly implemented and researched. Moreover, de Soysa *et al*. (2020) underlined the importance of the fact that socio-cultural barriers still restrict the involvement of women in competitive sports in Sri Lanka. Nevertheless, with such restrictions, the emergence of sporting activities at the university level, such as basketball, has offered new opportunities to female athletes to participate in systematic conditioning programs. Incorporating evidence-based practices, such as HIIT, may thus be a radical concept of enhancing female athletic performance in the local setting.

Fatigue and Injury Considerations in Female Basketball Players

Accumulation of fatigue enhances musculoskeletal injury, particularly of the lower extremities. According to Senanayake *et al*. (2022), the lack of proper recovery and limited dorsiflexion of the ankle are also contributory factor in the number of injuries among Sri Lankan basketball players. The researchers identified a correlation between the risk of ankle injury and fatigue and ankle mobility, and the use of specific conditioning and recovery exercises is necessary. HIIT can be used to decrease overuse injuries and allow players to perform consistently during the competition by increasing fatigue resistance.

Despite the overwhelming international evidence on the benefits of HIIT to fatigue resistance, there is still little research specifically on the benefits of HIIT with respect to female university-level basketball players. There is a significant amount of literature on elite or adolescent athletes in a Western setting (Aschendorf *et al*., 2018; Stankovic *et al*., 2023). Research in sports science in Sri Lanka has been more focused on descriptive profiling and motivation, but not on intervention-based conditioning (Kariyawasam *et al*., 2019; Nadeeshani and Perera, 2025). This gap is the reason to consider the localized experimental studies to determine the impact of HIIT on the FI that will incorporate physiological, performance, and contextual variables. The proposed research is therefore interested in feeding into this emerging field by empirically investigating whether HIIT has the power of constitutively decreasing fatigue and increasing performance among Sri Lankan female basketball players.

METHODOLOGY

This study uses a quantitative research design of a pre-test and post-test control group (CG) study to find out the effect of HIIT/on FI of university level female basketball players. To achieve the purpose, 20 women basketball players age 18–25 were selected from the University of Jaffna, Sri Lanka. They were divided into two equal groups at random. The group of participants was subjected to 8-week HIIT training in addition to their regular basketball practice. CG: Those who do not change their present training program and use HIIT. The target population includes female university basketball players representing state universities in Sri Lanka. Sample Size: 20 athletes (10 per group) Sampling Method: Purposive sampling – selecting players with similar competitive experience and training schedules. The dependent variable, FI will be measured using the Running-based Anaerobic Sprint Test. This test assesses the athlete's capacity to sustain a high power output during 6 consecutive 35-meter sprints with shorter periods of recovery.

Lower levels of fatigue resistance are indicated by lower values of FI. This test has been confirmed as a valid test for team sport athletes (Wiewelhove *et al*., 2015). Furthermore, secondary measures, such as heart rate recovery and Rate of Perceived Exertion are going to be taken so that it is possible to estimate the trends of recovery and the level of perceived fatigue. Pre-Test (Week 1): Baseline measurements of FI,

pre- and post-test were conducted on the FI before and after the experiment period. Collected data were analyzed by using one-way analysis of variance.

DATA ANALYSIS AND RESULTS

The chapter is a statistical analysis and interpretation of the data gathered to determine the impact of HIIT on the FI of female basketball players in the university level.

The decrease in the mean FI values suggests that the training interventions were effective in the positive way of influencing the endurance of the players. Nevertheless, the additional inferential analysis was conducted to prove the statistical significance.

Summary

The results confirm that HIIT has an important effect on decrease on FI in university-level female basketball players. The consistent decrease in fatigue levels across participants along with statistical significance in the results of the t-tests confirms the efficiency of HIIT as an efficient conditioning method compared to normal training. These results are consistent with previous research which showed enhanced anaerobic capacity and recovery efficiency using HIIT interventions in team sport athletes.

DISCUSSION

The aim of this study was to investigate the impact of HIIT on the FI in university-level female basketball players. The statistical analyses confirmed a significant decrease in a FI in the experimental group after 8 weeks of a HIIT intervention while in the CG, no significant improvement was detected in the FI. These results provide strong empirical support for the hypothesis that the HIIT can significantly increase fatigue resistance and anaerobic endurance in female basketball players. The observed enhancement is also in line with other researchers who have found out that HIIT enhances both aerobic and anaerobic capacity of performance. Stankovic *et al*. (2023) emphasized that HIIT is more effective in stimulating the maximum oxygen uptake (VO2max) and reducing the development of fatigue, especially among female athletes. On the same note, Aschendorf *et al*. (2018) and Capric *et al*. (2025) have demonstrated that HIIT exercises (sport specific) can indeed influence the ability of basketball players to enhance sprint performance and energy restoration abilities. The combination of these studies is in line with physiological processes observed in this study, including increases in muscle oxygenation, faster phosphocreatine resynthesis, and greater buffering capacity to lactate, which lead to reduced FI scores after intervention. This finding is similar to that of Wiewelhove *et al*. (2015), who found that controlled HIIT cycles promote more neuromuscular adaptation than standard endurance training alone. Moreover, the consistent improvements among all of the experimental participants [Figure 2] demonstrate that HIIT is not only effective, but also applicable to athletes of different fitness backgrounds. Importantly, this study is a contribution to the small body of Sri Lankan sports science literature dealing with female athletes. As mentioned by Kariyawasam *et al*. (2019) and Nadeeshani Perera (2025), female involvement in participation at the university level sports level is increasing but there is a lack of evidence based conditioning research. The present results thus provide useful local evidence in favor of the introduction of HIIT in university basketball training programs to improve competitive performances and decrease fatigue related injuries.

Table 1: Mean value of the experiment and control group

	n	Mean	Standard deviation	Standard error
Post				
Group 1	10	6.5930	0.10056	0.03180
Group 2	10	7.5020	0.14227	0.04499
Total	20	7.0475	0.48148	0.10766
Pre				
Group 1	10	7.4550	0.12295	0.03888
Group 2	10	7.7550	0.04649	0.01470

Table 2: Analysis of variance of the experiment and control group

	Sum of squares	df	Mean square	F	Sig.
Post					
Between groups	4.131	1	4.131	272.231	0.000
Within groups	0.273	18	0.015		
Pre					
Between groups	0.450	1	0.450	52.090	0.000
Within groups	0.155	18	0.009		

CONCLUSION

Based on findings, it can be concluded that the HIIT has a significant positive impact in reducing FI among the university level female basketball players. Players who received HIIT showed increased resistance to fatigue, better endurance and improved recovery capacity than those who followed standard training routines.

RECOMMENDATIONS

Coaches and physical trainers should incorporate structured HIIT programs at least 2–3 times/week within the basketball training cycle to improve fatigue resistance and overall fitness.

Studies could expand sample sizes, include physiological markers, such as lactate threshold and VOmax, or examine long term retention effects of HIIT adaptations. University sports departments in Sri Lanka should promote evidence based training systems, providing equal access and monitoring tools for female athletes to maximize athletic performance safely. In summary, the present study shows that HIIT is a better conditioning strategy which can greatly improve fatigue tolerance and performance in female basketball players. The results confirm the alternative hypothesis (H1) and are in line with research conducted globally that focuses on the use of HIIT as an effective, efficient, and scientifically based training method of enhancing athletic endurance.

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Research Article

Self-assessment practices in tertiary physical education: A correlational study

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ABSTRACT

This research was intended to investigate the relationship between self-assessment practices and learning and health outcomes of tertiary students enrolled in the PATHFIT program from four selected universities in the Philippines. The study focused on self-assessment practices in terms of self-rating, reflection, and self-awareness, and their influence on skill performance, health knowledge, and physical activity. The sample consisted of 358 students who were selected through stratified purposive sampling from a population of 5,100 PATHFIT students. A researcher-made questionnaire with 30 items was developed based on literature and validated through content and face validation, pilot testing, and reliability testing, resulting in a Cronbach's alpha of 0.90. The questionnaire was administered online with clear instructions and informed consent. The descriptive results revealed that students demonstrated high levels of self-assessment practices. The composite mean for self-rating was 3.37, reflection was 3.26, and self-awareness was 3.38. Learning and health outcomes were also high. The composite mean for skill performance was 3.35, health knowledge was 3.41, and physical activity was 3.27. Pearson correlation analysis showed significant positive relationships between overall self-assessment practices and skill performance ($r = 0.65$), health knowledge ($r = 0.60$), and physical activity ($r = 0.56$), with all $P < 0.01$. In conclusion, the study shows that self-assessment practices in PATHFIT improve skill mastery, reflective learning, and engagement in physical activity. The findings support the integration of structured self-assessment strategies in tertiary physical education programs to promote metacognitive development, student-centered learning, and lifelong wellness.

Keywords: Health outcomes, Learning outcomes, Self-assessment, Tertiary physical education

INTRODUCTION

Physical education (PE) is increasingly recognized as a vital part of holistic development in higher education, going beyond skill acquisition to promote health literacy, active lifestyles, and lifelong wellness habits. In the Philippine tertiary context, programs such as PATHFIT address sedentary behaviors while aligning with student-centered and self-directed learning approaches that position learners as active participants in their development. By emphasizing autonomy and engagement, student-centered PE programs enhance personal responsibility for health-related behaviors (Malones, 2024) and are supported by experiential and technology-enhanced teaching models that accommodate diverse learner needs (Quoc, 2024). Integrating holistic and positive education principles further contributes to emotional and social well-being, reinforcing healthier lifestyle choices and supporting long-term physical activity engagement (Campoamor-Olegario *et al*., 2024). Despite demonstrated benefits, PE remains vulnerable to being sidelined, underscoring the need for institutional support and quality standards to ensure effectiveness and sustained student engagement (Pham and Nguyen, 2025; Tolentino and Sinio, 2024).

Self-assessment has emerged as a central strategy in student-centered PE, as it empowers learners to evaluate their own performance, identify strengths and areas for improvement, and set meaningful goals for progress. By engaging in self-assessment, students develop metacognitive awareness, enabling them to reflect critically on their learning processes and outcomes (Siegesmund, 2017), while also strengthening

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higher-order thinking and reflective skills essential for personal growth and effective learning (Kim, 2023). Moreover, self-assessment promotes self-regulated learning by encouraging students to take ownership of their development, set achievable goals, and systematically monitor their progress (Kim, 2023; Kim, 2024). Through this process, learners cultivate responsibility, time management, and diligent preparation – competencies that not only enhance performance in PE but also contribute to improved academic achievement and lifelong learning dispositions. Its effective implementation requires guidance to minimize bias, and its application within structured PE programs in Philippine universities remains underexplored (Otero-Saborido *et al*., 2021).

Programs such as PATHFIT put these principles into practice, developing students' physical literacy through structured sports and fitness activities that enhance motor skills, physical capacities, health knowledge, and sustainable habits. PATHFIT effectively improves fitness outcomes (Dimarucot *et al*., 2024) and emphasizes kinesthetic intelligence and independent learning (Malones, 2024). Nevertheless, the role of self-assessment in enhancing learning and health outcomes within PATHFIT remains underexplored. Integrating self-assessment aligns with PATHFIT's student-centered approach, fostering autonomy, reflective practice, and ownership of fitness progression (Malones, 2024; Velez, 2023) – while addressing challenges such as gender disparities in participation (Dimarucot *et al*., 2024) and emphasizing the need for professional development (Tagare, 2025). Skill performance, demonstrated through the consistent and proficient execution of sports movements, serves as a key indicator of motor competence and physical literacy, which are associated with greater engagement in lifelong physical activity and improved health outcomes (Gu *et al*., 2019; Ferkel *et al*., 2019).

Self-assessment also influences broader learning outcomes, including skill mastery, health knowledge, and reflective competencies. Within this framework, self-assessment connects students' awareness of their abilities with actual performance and health-related understanding, promoting reflective evaluation and deeper cognitive engagement (Cale and Harris, 2022; Azzaloualıdıne and Erturan, 2025). These outcomes support the transition from supervised PE to independent physical activity, which is shaped by motivation, confidence, and fitness awareness (Delito, 2023). Portfolio-based and reflective approaches empower students to manage their own activity, although effectiveness depends on teacher competence and program quality.

Despite evidence supporting self-assessment, its influence on achievement, motivation, and health behaviors in PE remains limited. Existing studies mainly focus on motor skill development and engagement, with most evidence coming from Western contexts - limiting applicability to Philippine universities (Otero-Saborido *et al*., 2021; Bujosa-Quetglas *et al*., 2023). Localized research is needed to clarify how self-assessment influences educational and health outcomes, informing culturally responsive strategies.

Understanding the relationship between self-assessment and student outcomes is really important in Philippine tertiary PE, where PE is a required part of general education. Structured self- and peer-assessment strategies improve skill acquisition and accuracy (Azzaloualıdıne and Erturan, 2025; Cale and Harris, 2022). Integrating self-assessment supports student-centered learning, informs teaching strategies, promotes long-term wellness, and highlights the need for professional development. To address these gaps, this study investigates how self-assessment practices – including self-rating, reflection, and self-awareness – relate to learning and health outcomes among tertiary PE students in Philippine universities, providing insights to improve teaching, curriculum design, and policy initiatives (Malones, 2024; Trigueros Cervantes *et al*., 2016; Millard and Breukelman, 2025).

MATERIALS AND METHODS

Research Design

This study used a descriptive correlational research design to find out the relationships between self-assessment practices and learning and health outcomes among PATHFIT students. This design was appropriate because it allowed the researchers to examine how strongly the independent variable, which is self-assessment practices, is associated with the dependent variables, namely, skill performance, health knowledge, and physical activity, without changing or manipulating any variables. The design also allowed for comparison of students' practices and outcomes across four universities, giving a broader and more contextualized understanding of self-assessment in tertiary PE settings.

Participants, Sampling Technique, and Sample Size

The participants of the study were students enrolled in tertiary PE courses from four selected universities in the Philippines. Based on enrollment records obtained from the respective PE departments, the estimated total population of PATHFIT students across the four universities was 5,100.

To determine an adequate and statistically representative sample size, the Raosoft sample size calculator was used with a 95% confidence level and 5% margin of error. This resulted in a recommended sample size of 358 respondents, which was considered sufficient to represent the population while remaining practical for data collection.

A stratified purposive sampling technique was used to ensure proportional representation from each participating university. Inclusion criteria required that respondents be officially

enrolled in a PATHFIT course during the data collection period, have attended at least 75% of class sessions, and voluntarily provide informed consent. This sampling approach ensured balanced representation across institutions. Of the total 5,100 students, Institution 1 had 1,500 enrollees, from which 105 respondents were drawn. Institution 2, with 1,320 students, contributed 92 respondents. Institution 3 had 1,050 students, yielding 74 respondents, while Institution 4, with 1,230 students, provided 87 respondents. Altogether, this resulted in a total sample size of 358 students representing the four selected universities.

Data Gathering Instrument

The study used a researcher-made questionnaire as the primary data gathering instrument. The instrument was developed following the creation, validation, administration, and scoring (CVAS) framework, which stands for CVAS, a widely accepted methodological practice in Philippine educational research. During the creation phase, the questionnaire was built based on an extensive review of related literature on self-assessment practices, reflective learning, assessment in PE, and health-related behaviors. The instrument had two major parts that matched the objectives of the study. Part I measured self-assessment practices in terms of self-rating, reflection, and self-awareness, while Part II assessed learning and health outcomes in terms of skill performance, health knowledge, and physical activity. Each sub variable was represented by five indicators, resulting in a total of 30 items.

For the validation phase, the questionnaire went through content and face validation by a panel of experts composed of PE specialists, assessment experts, and research methodologists. The experts evaluated the relevance, clarity, and alignment of the items with the study objectives. Revisions were made based on the panel's recommendations to improve the instrument's clarity and content accuracy before pilot testing.

A pilot test was conducted among 50 PATHFIT students who were not included in the final sample to check the reliability of the instrument. The internal consistency of the questionnaire was determined using Cronbach's alpha. The results showed reliability, a Cronbach's alpha of 0.90, indicating excellent internal consistency. These findings confirmed that the instrument was reliable and ready for use in the main data collection.

During the administration phase, the validated questionnaire was distributed to the selected respondents through an online survey platform with the help of PATHFIT instructors and institutional coordinators. Participation was voluntary, and respondents were assured of the confidentiality and anonymity of their responses.

For scoring, a four-point Likert scale was used to measure the extent to which respondents agreed with each statement. The scale was interpreted as follows: 4 = very high, 3 = high, 2 = low, and 1 = very low. Weighted mean scores were computed for each indicator and subvariable. The resulting mean values were interpreted using the following verbal descriptions: 3.50–4.00 (very high), 2.50–3.49 (high), 1.50–2.49 (low), and 1.00–1.49 (very low). Higher mean scores indicated higher levels of self-assessment practices and learning and health outcomes among PATHFIT students.

Data Gathering Procedure

Before data collection, formal permission was secured from the administrators and PE coordinators of the participating universities. Coordination meetings were held with PATHFIT instructors to explain the objectives of the study, the data collection process, and the roles of the instructors in helping access the respondents. Ethical clearance from the institutional research ethics committee was obtained before the questionnaire was administered.

Data gathering was conducted during the regular academic term to make sure that respondents had enough exposure to PATHFIT course activities. The finalized and validated questionnaire was administered using an online survey platform, which allowed efficient distribution and easy participation across the four universities. A brief orientation and written instructions were provided at the beginning of the survey to guide respondents on how to answer the questionnaire correctly. Students who met the inclusion criteria were invited to participate through official course communication channels with the help of their instructors.

Before answering the questionnaire, participants were required to read an electronic informed consent form explaining the purpose of the study, the voluntary nature of participation, and the confidentiality of responses. Only those who gave their consent were allowed to proceed with the survey. To minimize response bias, respondents were encouraged to answer honestly and were assured that their responses would not affect their course grades or academic standing.

The data collection period lasted approximately 2–3 weeks, allowing enough time for follow-ups and reminders to reach the target sample size. Responses were automatically recorded in a secure database accessible only to the researchers. Once data gathering was done, all responses were reviewed for completeness and eligibility before data coding and statistical analysis began. This systematic procedure ensured accuracy, ethical compliance, and the reliability of the collected data.

Data Analysis

After data collection, all responses were checked for completeness and accuracy before being encoded for analysis. The data were organized and processed using Jamovi statistical software, which allowed for efficient computation of both

descriptive and inferential statistics. Descriptive statistics were used to address the first two objectives of the study. Specifically, weighted mean and standard deviation (SD) were calculated to determine the level of self-assessment practices of PATHFIT students in terms of self-rating, reflection, and self-awareness, as well as the level of learning and health outcomes in terms of skill performance, health knowledge, and physical activity. The computed mean scores were interpreted using the established verbal interpretations corresponding to the four-point Likert scale.

To address the third objective, which examined the relationship between self-assessment practices and learning and health outcomes, Pearson's product moment correlation coefficient was used. This statistical test was appropriate because the variables were measured on an interval scale and the study aimed to determine the strength and direction of the relationships between the independent and dependent variables. Correlation analyses were conducted between overall self-assessment practices and overall learning and health outcomes, as well as among their respective sub-variables.

All inferential statistical tests were evaluated at a 0.05 level of significance. Correlation coefficients were interpreted using standard guidelines, where values close to ±1 indicated stronger relationships. The results of the statistical analyses were presented in table form, along with narrative interpretations to make the findings easy to understand. The use of Jamovi ensured accurate, reproducible, and efficient analysis, allowing for a thorough examination of the relationships among the study variables in line with the study objectives.

Ethical Statement

This study strictly followed ethical principles in conducting research involving human participants. Before data collection, formal approval was obtained from the appropriate academic research ethics committee of the participating institutions. All respondents were informed of the study's purpose, procedures, and their rights through an introductory information sheet embedded in the online survey form. Participation was entirely voluntary, and respondents were informed that they could withdraw from the study at any time without any penalty or consequence. Electronic informed consent was obtained from all participants before they proceeded with the questionnaire. No personally identifying information was collected, ensuring the anonymity and confidentiality of responses. All data were securely stored in password-protected files accessible only to the researchers and were used solely for academic and research purposes. The conduct of the study followed the ethical principles outlined in the Declaration of Helsinki (World Medical Association, 2013) and the Commission on Higher Education Memorandum Order No. 15, Series of 2019, which emphasize respect for persons, beneficence, justice, and integrity in higher education research.

RESULTS

This section presents the findings of the study on self-assessment practices and learning and health outcomes of PATHFIT students. Results are organized according to the study objectives.

Self-Assessment Practices

Descriptive statistics were computed to determine the level of self-assessment practices in terms of self-rating, reflection, and self-awareness. Table 1 presents the mean scores and SDs for all indicators under the three dimensions of self-assessment practices.

Table 1 presents the descriptive statistics for self-assessment practices in terms of self-rating, reflection, and self-awareness. Self-rating obtained a composite mean of 3.37 SD = 0.64), interpreted as high, with item means ranging from 3.29 to 3.48. Reflection recorded a composite mean of 3.26 (SD = 0.64), also interpreted as high, and item means ranged from 3.22 to 3.30. Self-awareness yielded a composite mean of 3.38 (SD = 0.61), interpreted as high, with item means ranging from 3.34 to 3.41. Among the three dimensions, self-awareness obtained the highest composite mean, while reflection obtained the lowest.

Learning and Health Outcomes

Descriptive statistics were also computed to determine the level of learning and health outcomes in terms of skill performance, health knowledge, and physical activity. Table 2 presents the descriptive statistics for these variables.

Table 2 presents the descriptive statistics for learning and health outcomes in terms of skill performance, health knowledge, and physical activity. Skill performance obtained a composite mean of 3.35 (SD = 0.60), interpreted as High, with item means ranging from 3.31 to 3.40. Health knowledge recorded a composite mean of 3.41 (SD = 0.57), interpreted as high, and item means ranged from 3.37 to 3.44. Physical activity yielded a composite mean of 3.27 (SD = 0.63), interpreted as high, with item means ranging from 3.24 to 3.30. Among the three outcome variables, health knowledge obtained the highest composite mean, while physical activity obtained the lowest.

Pearson correlation analysis revealed significant positive relationships between self-rating and skill performance ($r = 0.62$, $P < 0.01$), health knowledge ($r = 0.58$, $P < 0.01$), and physical activity ($r = 0.54$, $P < 0.01$). Similar significant positive correlations were found for reflection (r values ranging from 0.52 to 0.59, $P < 0.01$) and self-awareness (r values ranging from 0.57 to 0.64, $P < 0.01$). Overall self-assessment practices were also significantly correlated with skill performance ($r = 0.65$, $P < 0.01$), health knowledge ($r = 0.60$, $P < 0.01$), and physical activity ($r = 0.56$, $P < 0.01$).

Table 1: Self-assessment practices

Dimension	Indicator	M	SD	Interpretation
Self-rating	I rate my performance after practicing a skill in class	3.42	0.62	High
	I compare my performance with the class standards or rubric	3.35	0.65	High
	I identify which parts of my skills need improvement	3.48	0.59	High
	I track my progress over time in specific sports skills	3.31	0.66	High
	I set personal goals for improving my skill performance	3.29	0.68	High
	Composite Mean	3.37	0.64	High
Reflection	I write short notes about what I learned after class activities	3.28	0.63	High
	I reflect on the challenges I faced while practicing a skill	3.22	0.67	High
	I think about strategies to improve my performance	3.30	0.61	High
	I reflect on how my practice affects my overall fitness	3.25	0.65	High
	I evaluate my strengths and weaknesses in each activity	3.27	0.62	High
	Composite Mean	3.26	0.64	High
Self-awareness	I am aware of my current fitness level	3.38	0.60	High
	I recognize my skill level compared to peers	3.34	0.62	High
	I understand how my effort affects my improvement	3.41	0.59	High
	I notice changes in my performance after training	3.36	0.63	High
	I can identify what I need to improve in my fitness or skills	3.39	0.61	High
	Composite mean	3.38	0.61	High

SD: Standard deviation

Table 2: Learning and health outcomes

Dimension	Indicator	M	SD	Interpretation
Skill performance	I can successfully perform selected sports skills	3.40	0.57	High
	I can execute techniques correctly as taught by the instructor	3.35	0.59	High
	I can maintain consistency in performing sports skills	3.33	0.61	High
	I can apply the correct strategies during game situations	3.31	0.63	High
	I feel confident performing the skills in class activities	3.38	0.58	High
	Composite Mean	3.35	0.60	High
Health knowledge	I understand the importance of regular physical activity	3.44	0.55	High
	I know the proper techniques for safe exercise	3.42	0.57	High
	I am aware of how nutrition affects my fitness	3.37	0.59	High
	I can identify the benefits of different types of exercises	3.39	0.56	High
	I understand the principles of fitness development	3.41	0.57	High
	Composite Mean	3.41	0.57	High
Physical activity	I engage in physical activity outside of PATHFIT classes regularly	3.30	0.61	High
	I participate in sports or exercise at least 3–4 times/week	3.28	0.63	High
	I spend adequate time on cardiovascular or endurance activities	3.25	0.65	High
	I include strength or resistance exercises in my routine	3.24	0.64	High
	I set personal goals to maintain or improve my physical activity habits	3.27	0.62	High
	Composite mean	3.27	0.63	High

SD: Standard deviation

DISCUSSION

The findings of this study show that PATHFIT students consistently exhibit high levels of self-assessment, specifically through self-rating, reflection, and self-awareness, suggesting that they actively use metacognitive processes rather than simply performing physical tasks. This high level of engagement supports the idea that reflective

Table 3: Pearson correlation between self-assessment practices and learning and health outcomes

Variables	Skill performance (r)	Health knowledge (r)	Physical activity (r)
Self-rating	0.62**	0.58**	0.54**
Reflection	0.59**	0.55**	0.52**
Self-awareness	0.64**	0.61**	0.57**
Overall self-assessment practices	0.65	0.60	0.56

P<0.01, two-tailed – all correlations are statistically significant

practices are foundational to deep learning and skill development in PE (Catalan *et al*., 2024). By integrating these dimensions, students shift from passive recipients of instruction to active participants, a connection supported by the notion that combining self-rating with reflection is important for developing the self-regulation needed for technical skill acquisition (Azzaloualıdıne and Erturan, 2025). Furthermore, the positive reception of these methods among PATHFIT students mirrors evidence that students generally view self-assessment as an effective tool for improving overall learning outcomes (Otero-Saborido *et al*., 2021). However, while students show high self-awareness, the literature warns that without proper pedagogical guidance, such practices may lead to overconfidence or a misjudgment of actual technical proficiency (Cañadas, 2022). Ultimately, while the approach observed in this study is a strong indicator of student engagement, it highlights the need for structured frameworks to ensure that high levels of self-assessment translate into accurate and objective skill mastery.

Similarly, the high levels observed in learning and health outcomes, including skill performance, health knowledge, and physical activity, show the ability of students to translate reflective practices into effective wellness behaviors. This transition from classroom theory to active engagement aligns with findings that self-directed learning models significantly improve both individual and class performance while increasing student involvement (Nainggolan and Manalu, 2022). Such engagement is not limited to the school setting, as the high participation in physical activities beyond the classroom highlights the potential of self-directed strategies in promoting lifelong fitness. Moving beyond structured school activities is an important step in developing permanent healthy habits (Vaughn *et al*., 2019). Furthermore, the connection between quality PE and long-term wellness highlights the role of teacher competence and structured interventions, which are important for improving student self-efficacy and reinforcing support systems, including parental involvement, necessary to sustain fitness levels throughout life (Delito, 2023; Soriano Sánchez and Sastre-Riba, 2023).

The correlation analysis in this study shows that self-assessment practices are positively associated with both learning and health outcomes, particularly within the PE context. This relationship highlights the importance of self-monitoring and reflective activities in improving student competence and health-related behaviors. These findings are consistent with evidence that self-assessment improves learning by helping students clarify their objectives and monitor their own progress toward specific fitness goals (Setyawan *et al*., 2023). Furthermore, the impact on health outcomes is significant, as self-efficacy, a concept closely linked to self-assessment, influences the health behaviors and overall quality of life of PE students (Hidayah *et al*., 2025). Engaging in these practices also develops a sense of self-determination, which is essential for maintaining consistent physical activity and positive mental health (Cerbas, 2025). Finally, the successful application of these strategies within the Philippine tertiary education system shows that self-assessment is a highly adaptable and relevant teaching tool across diverse cultural and program settings (Mendoza and Yan, 2021).

Taken together, this study highlights the pedagogical value of integrating self-assessment strategies into tertiary PE programs, as these practices support metacognitive development, skill mastery, and sustained engagement. Systematic self-assessment encourages students to reflect critically on their learning processes, which improves self-regulation and develops a deeper understanding of personal strengths and weaknesses needed for lifelong learning (Bourke, 2014). Furthermore, the use of structured tools such as rubrics significantly improves skill acquisition by allowing students to evaluate their performance against objective criteria, particularly when these tools are created together with instructors to improve self-regulation. Beyond cognitive gains, these practices develop a sense of ownership over the learning process, making students active participants rather than passive recipients of instruction (Zhou *et al*., 2025). This connection between formative assessment and student motivation is important for the Bachelor of PE curriculum, as it shows that reflective practices are not only beneficial for immediate skill mastery but also for developing the long-term commitment to health and wellness required in the professional field.

CONCLUSION

This study concludes that PATHFIT students' self-assessment practices through self-rating, reflection, and self-awareness positively influence learning and health outcomes, supporting the idea that reflective strategies improve skill mastery, self-regulation, and engagement in physical activity. The findings contribute to the academic community by showing the effectiveness of structured self-assessment in promoting metacognitive development and lifelong wellness behaviors among tertiary PE students. While the study highlights

significant benefits, limitations include the potential overestimation of skills without guided feedback and a focus on a single program, suggesting that future research could explore diverse educational contexts and the long-term impact of self-assessment strategies.

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Research Article

An assessment of English learning barriers among physical education students in Southern Vietnam

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ABSTRACT

As Vietnam continues to deepen its international integration, English has become a core competency in higher education. Nevertheless, physical education students frequently report difficulties in using English effectively, while limited empirical research has examined their barriers within a clearly structured, skill-based framework. The finalized scale comprised 33 observed items loading onto four factors corresponding to listening, speaking, reading, and writing. The exploratory factor analysis demonstrated strong adequacy, explaining 77.49% of the total variance. Barrier levels were high across all skills, with speaking ($M = 4.49 \pm 0.39$) and writing ($M = 4.42 \pm 0.32$) emerging as the most prominent, followed by reading ($M = 4.30 \pm 0.43$) and listening ($M = 4.07 \pm 0.55$). Significant institutional differences were identified in listening and speaking ($P < 0.001$), whereas no significant differences were observed by gender or academic year. The findings underscore the need for output-oriented pedagogical interventions, sport-contextualized English curricula, and expanded opportunities for structured communicative practice.

Keywords: English learning barriers, Language skills, Physical education and sport students, Scale development, Vietnam

INTRODUCTION

English has become an essential academic and professional resource in contemporary higher education, particularly within contexts increasingly oriented toward international collaboration and knowledge exchange. In sport-related disciplines, English proficiency is not merely an auxiliary skill; it enables students to access international sport science literature, interpret evidence-based training guidelines, and communicate in professional environments that often extend beyond national boundaries. As English components and English for Specific Purposes (ESP) orientations expand within university curricula, physical education students are expected to engage with discipline-specific terminology and communicative tasks that align with their future careers. However, the effectiveness of such curricular efforts depends not only on institutional provision but also on learners' capacity to actively participate in English-mediated tasks and sustain skill development over time.

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A paradox thus emerges. While institutional expectations for English competence are rising, students' observable performance and communicative confidence often remain constrained. In many cases, these constraints cannot be explained solely by insufficient motivation. Research in second and foreign language education has long shown that learners may express willingness to improve yet struggle to participate due to anxiety, skill-specific difficulty, or contextual limitations (Dörnyei, 1994; 1998; Horwitz *et al*., 1986). For example, foreign language classroom anxiety, encompassing communication apprehension, test anxiety, and fear of negative evaluation, can inhibit oral participation even when learners recognize the value of English (Horwitz *et al*., 1986). Similarly, writing anxiety has been conceptualized as a multidimensional construct that disrupts planning, organization, and linguistic control (Cheng, 2004). These findings suggest that English learning challenges are often embedded in specific skill demands rather than in motivation alone. Without a systematic understanding of where barriers concentrate: Listening, speaking, reading, or writing interventions risk remaining broad and insufficiently targeted.

Conceptually, learning barriers may be understood as conditions that restrict learners' access to programs, reduce participation, or impair concentration and comprehension during learning processes (Qifu, 2013). Edwards (2012) further characterizes barriers as factors that limit learners' capacity and freedom to engage with learning opportunities, arising from both internal and external sources. Applied to second language acquisition, these perspective positions barriers as points of friction across the learning trajectory: They may disrupt input processing, constrain output production, and weaken persistence when repeated difficulty fosters avoidance. Importantly, such barriers do not operate uniformly across language skills. Listening requires rapid decoding and sustained attention; speaking involves real-time production under social evaluation; reading demands lexical inference and strategic comprehension; writing requires planning, coherence, and control over linguistic form. Skill-specific demands, therefore, "activate" different forms of constraint.

Existing scholarship reflects this multidimensionality. Beyond anxiety-focused frameworks (Horwitz *et al*., 1986; Cheng, 2004), broader barrier typologies have been identified in educational settings, including administrative, social, academic, technical, motivational, and access-related factors (Muilenburg and Berge, 2005; Mahmuda, 2021). In the Vietnamese context, studies have pointed to both individual and environmental constraints, such as limited authentic communication opportunities, heavy reliance on teacher-centered instruction, and insufficiently engaging materials (Thảo, 2020; Mỹ, 2024). While these categorizations are analytically informative, they often remain broad. For curriculum designers and instructors, a more actionable framework may be one that maps barriers directly onto the four foundational language skills. Such an approach allows educators to identify which domain requires priority and how instructional practices might be recalibrated accordingly.

Despite the recognized importance of English in sport-related education, two notable gaps remain. First, there is a lack of a standardized, context-sensitive measurement scale structured explicitly around the four language skills for physical education students in Vietnam. Existing instruments typically target general EFL populations or focus on isolated constructs (e.g., anxiety), leaving the skill-based configuration underdeveloped for this specific academic field. Second, empirical evidence across multiple institutions is limited. Without multi-university data, it remains unclear whether observed barriers reflect individual characteristics or structural differences across training environments. Addressing these gaps is necessary for building a robust empirical foundation for program-level improvement.

Accordingly, the present study pursues two objectives. First, it develops and validates a four-skill scale of English learning barriers among physical education students. Second, it describes barrier levels and examines differences by gender, academic year, and university setting. Methodologically, the study contributes a measurement instrument that enables a skill-based assessment of specific barriers affecting English learning among physical education students. Practically, it identifies priority bottlenecks, particularly within output-oriented skills that can inform the design of sport-contextualized English coursework and the expansion of structured communicative practice. By integrating a skill-based barrier framework with multi-institutional evidence, this study seeks to provide a theoretically grounded and operationally useful foundation for improving English learning among sport-related university students.

RESEARCH DESIGN

A two-phase design was employed. The first phase focused on scale development and validation, yielding 200 valid responses. Cronbach's alpha was used to assess internal consistency, followed by exploratory factor analysis (EFA) to determine the factor structure and remove items that did not meet statistical criteria. The second phase adopted a cross-sectional survey design. Convenience sampling was conducted at six universities between March and May 2024. A total of 603 valid responses were included in the final analysis, with usable data obtained from six participating institutions.

Participants

The final sample consisted of 603 physical education students. Male students accounted for 69.0% of the sample and female students for 31.0%. Responses were distributed across six institutions: Ho Chi Minh City University of Education (8.5%), Ho Chi Minh City University of Physical Education and Sport (10.3%), Tay Nguyen University (9.8%), Quy Nhon University (4.3%), Dong Thap University (7.1%), and Ho Chi Minh City University of Physical Education and Sport Education (60.0%). In terms of academic year, 1st -year students represented 46.3% of the sample, 2nd-year students 10.6%, 3rd students 21.1%, and final-year students 21.1%. Data were collected through both face-to-face distribution and online administration via Google Forms. Participation was voluntary and anonymous. Only complete responses were included in the analysis.

Data Analysis

Phase 1 involved Cronbach's alpha and EFA using principal component analysis (PCA) with Varimax rotation. Phase 2 employed descriptive statistics to calculate means and standard deviations. Independent-samples *t*-tests examined gender differences, and one-way analysis of variance (ANOVA) tested differences across academic years and universities. Welch's test was applied when the homogeneity of variance assumptions were not met.

RESULTS AND DISCUSSION

Development of the Scale Measuring English Learning Barriers among Physical Education Students

The development of the scale measuring English learning barriers among physical education students was conducted through a systematic process consisting of six stages: (i) Synthesizing and systematizing measurement criteria from previous studies; (ii) translation and contextual adaptation; (iii) expert content validation; (iv) pilot testing; (v) official survey for reliability and construct validation; and (vi) finalization of the instrument for subsequent analyses. A review of the literature revealed multiple approaches to conceptualizing and measuring barriers in foreign language learning. The foreign language classroom anxiety scale (FLCAS) developed by Horwitz *et al*. (1986) includes 33 items focusing on classroom anxiety, encompassing communication apprehension, test anxiety, and fear of negative evaluation. Cheng (2004) proposed a 22-item Second Language Writing Anxiety Scale structured around cognitive anxiety, somatic anxiety, and avoidance behavior, providing a skill-specific example of barrier measurement. From a broader perspective, Muilenburg and Berge (2005) identified eight categories of learning barriers, including administrative issues, social interaction, academic skills, technical skills, learner motivation, time and support, cost and Internet access, and technical problems. Mahmuda (2021) identified seven barriers in online English learning, emphasizing Internet access, technological skills, rigidity of learning materials, limited resources, insufficient support services, economic burden, and restricted interaction with instructors.

In the Vietnamese context, Thảo (2020) used a 13-item questionnaire and categorized barriers into four groups: Insufficient English background knowledge, inappropriate learning strategies, discomfort or lack of confidence in language use, and socio-economic constraints combined with ineffective study habits. Chi and Thủy (2023) applied the FLCAS to examine English learning anxiety, while Mỹ (2024), through qualitative inquiry, identified barriers related to unengaging materials, limited authentic communication activities, negative peer influence, and strong dependence on teaching methods. Based on this synthesis, the study initially selected 40 preliminary criteria representing common barriers across the four language skills: Listening, speaking, reading, and writing. For items adapted from international instruments, a forward-backward translation procedure following Beaton *et al*. (2000) was applied, with contextual adjustments to ensure linguistic and cultural appropriateness for Vietnamese physical education students.

Subsequently, five experts in sport education, applied linguistics, and educational measurement participated in the content validation process. Each item was evaluated in terms of clarity, contextual relevance, and conceptual representativeness. Items that did not reach at least 80% agreement were revised or reconsidered. The validation results indicated only minor terminological adjustments, without substantive changes to item content, and overall expert agreement was high.

A pilot study was then conducted with 50 physical education students independent of the main sample to examine item wording, structure, and preliminary reliability. The 40-item scale achieved a Cronbach's alpha coefficient of 0.946, indicating very high internal consistency. Corrected item-total correlations met acceptable thresholds, and no items were removed at this stage. The official survey for scale construction was conducted with 200 participants, meeting the minimum sample size requirement for EFA.

Internal Reliability Analysis

Following data screening and preliminary computation, internal consistency was examined using Cronbach's alpha. The initial 40-item scale yielded an overall Cronbach's alpha of 0.906, indicating high reliability. Item-total statistics were subsequently reviewed to assess the contribution of each observed variable. Seven items that did not satisfy the established criteria for internal consistency, specifically those with corrected item-total correlations below 0.30 and/or weak contribution to the overall scale reliability, were removed from further analysis. After item purification, the refined 33-item scale demonstrated satisfactory internal consistency, with Cronbach's alpha coefficients exceeding the recommended threshold of 0.60 and corrected item-total correlations above 0.30 across retained items. These findings confirm that the revised instrument achieved acceptable internal reliability and was suitable for subsequent EFA.

EFA

The results of the EFA indicated that the Kaiser-Meyer-Olkin measure of sampling adequacy reached 0.911, exceeding the recommended threshold of 0.50 and demonstrating that the data were highly suitable for factor analysis. In addition, Bartlett's Test of Sphericity was statistically significant, $\chi^2(528) = 7730.85$, $P < 0.001$, confirming that the observed variables were sufficiently intercorrelated to justify factor extraction.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin measure of sampling adequacy		0.911
Bartlett's test of sphericity	Approx. Chi-square	7730.85
	Degrees of freedom	528
	Significance	0.000

Factor extraction was conducted using PCA with Varimax rotation and Kaiser normalization. The results yielded four

Table 1: Exploratory factor analysis of the English learning barriers scale

Code	Items	Group			
		Listening	Writing	Reading	Speaking
LS4	I am unable to ask the speaker to repeat	0.901			
LS8	I do not have opportunities to listen to native speakers to become familiar with their speech	0.884			
LS6	I do not know how to take notes effectively while listening in English and fail to identify important cues or keywords	0.864			
LS7	I am unable to distinguish main words or key phrases within a sentence	0.862			
LS9	Poor audio quality negatively affects my listening comprehension	0.862			
LS2	I have limited vocabulary knowledge	0.858			
LS1	I cannot keep up with the speaker's rate of speech	0.849			
LS3	I lose concentration due to the surrounding noise while listening	0.834			
LS5	I have difficulty understanding different accents	0.826			
SS9	I have difficulty arranging words into correct English sentences		0.906		
SS2	My vocabulary is limited		0.884		
SS7	Cultural differences make me feel less confident when speaking English		0.882		
SS10	I do not have opportunities to practice speaking English with native speakers		0.878		
SS4	I have difficulty speaking fluently		0.868		
SS6	I feel anxious and embarrassed when speaking		0.863		
SS8	I lack the motivation to learn speaking skills in English		0.857		
SS3	My grammatical knowledge is limited		0.850		
WS3	I have difficulty with spelling when writing in English			0.907	
WS5	I have difficulty generating ideas for writing tasks			0.892	
WS9	I have difficulty outlining my writing			0.887	
WS4	I have difficulty constructing sentences when writing in English			0.884	
WS1	I lack sufficient vocabulary when writing in English			0.874	
WS8	I have difficulty using cohesive devices when writing in English			0.865	
WS6	I have difficulty organizing ideas in my writing			0.858	
WS7	I have difficulty using punctuation correctly when writing in English			0.842	
RS8	I feel stressed when reading English texts in class				0.902
RS10	I have difficulty summarizing the main ideas of a passage				0.900
RS7	I tend to translate word by word when reading				0.894
RS1	I have difficulty guessing the meaning of new words				0.873
RS9	I feel less confident when learning reading skills				0.858
RS4	I have difficulty applying reading techniques effectively				0.858
RS3	I have difficulty using reading strategies effectively				0.849
RS2	I have difficulty identifying the purpose of a reading task				0.842

Extraction Method: Principal component analysis. Rotation Method: Varimax with Kaiser normalization. a. Rotation converged in 4 iterations

factors with a cumulative variance explained of 77.49%, exceeding the commonly accepted threshold of 50% and indicating strong explanatory power for the scale structure.

Accordingly, the study developed a 33-item scale to measure English learning barriers among physical education students. The scale is structured into four dimensions corresponding

Table 2: Gender differences in English learning barriers among physical education students

Skill	Gender	*n*	Mean	Standard deviation	t	*P*-value
Listening	Male	416	4.08	0.56	0.627	0.531
	Female	187	4.05	0.54		
Reading	Male	416	4.31	0.43	0.645	0.519
	Female	187	4.28	0.43		
Writing	Male	416	4.42	0.32	0.079	0.937
	Female	187	4.42	0.32		
Speaking	Male	416	4.5	0.4	1.031	0.303
	Female	187	4.47	0.37		

Table 3: Academic year differences in English learning barriers among physical education students

Skill	Academic year	*n*	Mean	Standard deviation	F	*P*-value
Listening	1st year	155	4.04	0.55	1.892	0.13
	2nd year	141	4.01	0.5		
	3rd year	158	4.15	0.59		
	Final year	149	4.07	0.56		
Reading	1st year	155	4.32	0.43	0.481	0.696
	2nd year	141	4.26	0.41		
	3rd year	158	4.3	0.43		
	Final year	149	4.32	0.44		
Writing	1st year	155	4.39	0.34	0.716	0.543
	2nd year	141	4.42	0.31		
	3rd year	158	4.44	0.31		
	Final year	149	4.42	0.31		
Speaking	1st year	155	4.5	0.41	1.661	0.174
	2nd year	141	4.44	0.35		
	3rd year	158	4.5	0.4		
	Final year	149	4.54	0.4		

to the four language skills: Listening (9 items), writing (8 items), reading (8 items), and speaking (8 items). All items are measured on a five-point Likert scale reflecting the frequency with which students experience each barrier, ranging from 1 (Never) to 5 (Very Often). Mean scores were used to interpret the level of barriers, with the following thresholds: 1.00–1.80 indicating very low barriers; 1.81–2.60 low barriers; 2.61–3.40 moderate barriers; 3.41–4.20 high barriers; and 4.21–5.00 very high barriers, suggesting that students frequently or very frequently encounter such difficulties. Across a systematic process involving theoretical synthesis, expert validation, pilot testing, and official survey analysis, the study finalized

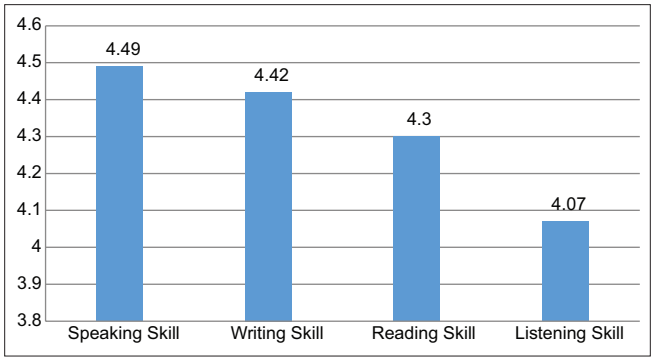

Figure 1: English learning barriers among physical education students

a psychometrically sound instrument for assessing English learning barriers among physical education students. The scale demonstrates methodological rigor, including content validity and internal reliability, and is well aligned with the educational context under investigation. Its application enables a structured and comprehensive assessment of both the level and characteristics of barriers in English learning, thereby providing a robust foundation for subsequent analyses and pedagogical implications.

Identification of English Learning Barriers among Physical Education Students

Convenience sampling was employed during the early period of the second semester of the 2023–2024 academic year (March–May 2024). A total of 603 valid responses were obtained from participating students. The findings indicated that physical education students experienced barriers across all four language skills. Among them, speaking presented the highest level of perceived barriers (M = 4.49 ± 0.39), followed by writing (M = 4.42 ± 0.32) and reading (M = 4.30 ± 0.43), whereas listening showed a relatively lower mean score (M = 4.07 ± 0.55). These findings suggest that productive skills, particularly speaking and writing, constitute more salient challenges compared to receptive skills, such as listening and reading.

Table 4: Institutional differences in English learning barriers among physical education students

Skill	Universities	*n*	Mean	Standard deviation	F	*P*-value
Listening	Ho Chi Minh City University of Education	51	4.06	0.54	6.903	<0.001
	Ho Chi Minh City University of Sport	62	4.06	0.41		
	Tay Nguyen University	59	4.07	0.59		
	Quy Nhon University	26	3.71	0.5		
	Dong Thap University	43	4.09	0.52		
	Ho Chi Minh City University of Physical Education and Sport	362	4.2	0.63		
Reading	Ho Chi Minh City University of Education	51	4.37	0.45	1.689	0.135
	Ho Chi Minh City University of Sport	62	4.22	0.4		
	Tay Nguyen University	59	4.3	0.45		
	Quy Nhon University	26	4.31	0.46		
	Dong Thap University	43	4.33	0.42		
	Ho Chi Minh City University of Physical Education and Sport	362	4.34	0.41		
Writing	Ho Chi Minh City University of Education	51	4.41	0.33	0.885	0.491
	Ho Chi Minh City University of Sport	62	4.45	0.3		
	Tay Nguyen University	59	4.38	0.34		
	Quy Nhon University	26	4.44	0.31		
	Dong Thap University	43	4.38	0.3		
	Ho Chi Minh City University of Physical Education and Sport	362	4.42	0.33		
Speaking	Ho Chi Minh City University of Education	51	4.47	0.38	14.833	<0.001
	Ho Chi Minh City University of Sport	62	4.29	0.31		
	Tay Nguyen University	59	4.54	0.38		
	Quy Nhon University	26	4.52	0.46		
	Dong Thap University	43	4.49	0.39		
	Ho Chi Minh City University of Physical Education and Sport	362	4.65	0.37		

Within the speaking dimension, mean scores ranged from 4.27 to 4.89, indicating a consistently very high level of perceived barriers. The most prominent barrier was SS6_I feel anxious and embarrassed when speaking (M = 4.89 ± 0.33), highlighting psychological factors as a critical constraint in English communication. For listening, mean scores varied from 3.94 to 4.47. The highest-rated barrier was LS1_I cannot keep up with the speaker's rate of speech (M = 4.47 ± 0.66), suggesting that processing speed and real-time comprehension pose significant challenges. In reading, all items were reported at high levels (M = 4.10–4.70). The most salient difficulty was RS7_I tend to translate word by word when reading (M = 4.70 ± 0.55), indicating that reliance on word-by-word translation substantially hinders reading comprehension. Regarding writing, mean scores ranged from 4.29 to 4.64. The most significant barrier was WS5_I have difficulty generating ideas for writing tasks (M = 4.64 ± 0.50), followed by WS1_I lack sufficient vocabulary when writing in English (M = 4.57 ± 0.56) and WS3_I have difficulty with spelling when writing in English (M = 4.56 ± 0.50). Other writing-related challenges, including WS9_I have difficulty outlining my writing (M = 4.32 ± 0.91), WS6_I have difficulty organizing ideas in my writing (M = 4.32 ± 0.70), WS8_I have difficulty using cohesive devices when writing in English (M = 4.32 ± 0.71), WS4_I have difficulty constructing sentences when writing in English (M = 4.32 ± 0.90), and WS7_I have difficulty using punctuation correctly when writing in English (M = 4.29 ± 0.92), were also reported at high levels.

Overall, speaking emerged as the most prominent barrier for physical education students, primarily driven by psychological constraints, such as anxiety and embarrassment, alongside limitations in fluency, grammar, and vocabulary. Writing ranked second, with difficulties centered on idea generation, lexical resources, and spelling. Reading was strongly affected by word-by-word translation habits and reduced confidence, whereas listening barriers were mainly associated with rapid speech, limited vocabulary, and suboptimal listening conditions. The consistently high levels across skills suggest the need for targeted pedagogical interventions, particularly strengthening oral communication, while simultaneously enhancing reading and listening strategies and improving learning resources and practice environments.

Group Differences in English Learning Barriers among Physical Education Students

Gender

The analysis indicated no statistically significant differences in English learning barriers between male and female physical education students. Overall patterns were highly comparable across the four language skills. Specifically, for listening, male students reported a slightly higher mean score (M = 4.08 ± 0.56) compared to female students (M = 4.05 ± 0.54). A similar pattern was observed in reading, with males (M = 4.31 ± 0.43) marginally exceeding females (M = 4.28 ± 0.43). Writing barriers were virtually identical between the two groups (M = 4.42 ± 0.32 for both males and females). In speaking, male students again showed a marginally higher mean score (M = 4.50 ± 0.40) compared to female students (M = 4.47 ± 0.37). Despite these minor numerical differences, inferential analysis (independent samples *t*-tests) confirmed that none of the observed differences reached statistical significance. These findings suggest that English learning barriers among physical education students are not meaningfully associated with gender.

In addition, independent samples t-tests confirmed that the observed differences between male and female students were not statistically significant at the 95% confidence level. Specifically, no significant differences were found in listening barriers (t = 0.627, $P > 0.05$), reading barriers (t = 0.645, $P > 0.05$), writing barriers (t = 0.079, $P > 0.05$), or speaking barriers (t = 1.031, $P > 0.05$). These findings indicate that English learning barriers among physical education students do not differ meaningfully by gender.

Academic year

The analysis further examined differences across academic years. Although slight variations in mean scores were observed, the overall pattern remained largely comparable across cohorts. For listening barriers, 3rd-year students reported the highest mean score (M = 4.15 ± 0.59), followed by final-year students (M = 4.07 ± 0.56), 1st-year students (M = 4.04 ± 0.55), and 2nd-year students (M = 4.01 ± 0.50). Reading barriers ranged narrowly between 4.26 and 4.32, indicating minimal variation across academic years. Writing barriers were similarly consistent, with mean scores ranging from 4.39 ± 0.34 among 1st-year students to 4.44 ± 0.31 among 3rd-year students. Regarding speaking barriers, final-year students reported the highest level (M = 4.54 ± 0.40), followed by 1st- and 3rd-year students (M = 4.50), while 2nd-year students showed slightly lower scores (M = 4.44 ± 0.35). Overall, despite minor fluctuations, the mean differences across academic years were relatively small and did not suggest substantial divergence in perceived English learning barriers.

However, the results of the one-way ANOVA indicated that these differences were not statistically significant at the 95% confidence level across all barrier categories: Listening ($F(3, 599) = 1.892$, $P > 0.05$), reading ($F(3, 599) = 0.481$, $P > 0.05$), writing ($F(3, 599) = 0.716$, $P > 0.05$), and speaking ($F(3, 599) = 1.661$, $P > 0.05$). The Welch test similarly confirmed the absence of statistically significant differences ($P > 0.05$ across all skills). These findings suggest that English learning barriers among physical education students do not differ meaningfully by academic year.

University

In contrast, the analysis revealed variation in mean barrier scores across institutions. For listening barriers, students from Ho Chi Minh City University of Physical Education and Sport reported the highest mean score (M = 4.20 ± 0.63), whereas students from Quy Nhon University reported the lowest (M = 3.71 ± 0.50). Reading barriers showed relatively small variation across institutions, with mean scores ranging from 4.22 to 4.37. Writing barriers were also distributed fairly evenly (M = 4.38–4.45). More pronounced differences emerged in speaking barriers. Students from Ho Chi Minh City University of Physical Education and Sport reported the highest level (M = 4.65 ± 0.37), whereas students from Ho Chi Minh City University of Education reported comparatively lower scores (M = 4.29 ± 0.31).

The results of the one-way ANOVA indicated statistically significant differences at the 95% confidence level for listening barriers ($F[5, 597] = 6.903$, $P < 0.001$) and speaking barriers ($F[5, 597] = 14.833$, $P < 0.001$). In contrast, no statistically significant differences were found for reading barriers ($F[5, 597] = 1.689$, $P > 0.05$) or writing barriers ($F[5, 597] = 0.885$, $P > 0.05$). The Welch test further confirmed significant differences across institutions for listening and speaking skills ($P < 0.001$), while differences in reading and writing remained non-significant. These findings suggest that English learning barriers among physical education students vary significantly by institution in the domains of listening and speaking, whereas barriers related to reading and writing appear relatively consistent across universities.

CONCLUSION

This study successfully developed and validated a 33-item scale measuring English learning barriers among physical education students, structured across four language skills: Listening, speaking, reading, and writing. EFA confirmed a four-factor structure with satisfactory reliability and construct validity. Empirically, the results demonstrate high levels of perceived barriers across all skills, with speaking and writing emerging as the most prominent domains of difficulty. Comparative analysis revealed significant differences by institution in listening and speaking, while no significant differences were identified by gender or academic year. These findings provide quantitative evidence regarding both the structure and intensity of English

learning barriers among physical education students. Moreover, the results underscore the influence of educational context in shaping students' language learning experiences.

LIMITATIONS AND RECOMMENDATIONS

This study employed convenience sampling, and participant distribution across institutions was uneven, with one university accounting for a substantial proportion of the sample. These factors may limit the generalizability of the findings. Future research should validate the scale structure using confirmatory factor analysis or structural equation modeling with independent samples. Pre- and post-intervention designs are recommended to examine the effectiveness of targeted pedagogical strategies, while qualitative approaches may provide deeper insight into institutional differences and the mechanisms underlying perceived barriers.

In response to the identified barriers, interventions should be implemented at multiple levels. At the classroom level, greater emphasis on task-based speaking activities, supportive feedback, and transparent rubrics for speaking and writing is recommended, alongside short micro-practice sessions to increase practice frequency and reduce performance anxiety. At the program level, English courses should adopt an ESP orientation aligned with sport-related contexts, incorporating professional scenarios to enhance functional language use. At the institutional level, universities should cultivate supportive learning environments through sport-themed English clubs, peer buddy systems, and expanded access to quality language input, while ensuring psychologically safe spaces for output practice.

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Research Article

A survey study of attitude toward sports and games of rural living people in Hyderabad of Telangana State

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ABSTRACT

The purpose of the study was to find out the attitude toward sports of rural living people. To achieve these, 200 female subjects were randomly selected as subjects from four villages in Hyderabad, Telangana, so that a standard program for rural participation in sports can be planned in the future. The instrument used for this research project were interview schedules and questionnaires, which were prepared carefully to obtain the responses from the subjects selected from the different parts of Hyderabad, Telangana. The following procedures were adopted for the questionnaire development: 1. Pre-pilot study phase, 2. Pooling of statements, 3. Selection of statements, 4. Pilot study phase (Jury opinion), 5. Rewriting, and 6. Finalization phase. The reliability was established using the test and retest method. The reliability of the whole test for all the statements is found using the Spearman–Brown Prophecy formula. The selected subjects were tested on selected criterion variables, and one-way analysis of variance was used to find out the significant differences.

Keywords: Interviewed schedules, Questionnaires, Rural living male and females

INTRODUCTION

A sport consists of a physical activity or skill carried out with a recreational purpose for competition, for self-enjoyment, to attain excellence, for the development of a skill, or some combination of these. During the era of the Rig Veda, Ramayana, and Mahabharata, men of a certain stature were expected to be well versed in chariot-racing, archery, military stratagems, swimming, wrestling, and hunting. Excavations at Harappa and Mohenjo-Daro confirm that during the Indus Valley Civilization (2500–1500 B.C.), the weapons involved in war and hunting exercises included the bow and arrow, the dagger, the axe, and the mace, etc.

India has a tradition of sports and physical fitness. In recognition of the importance of sports, a separate department was set up in 1982, before the commencement of the 9th Asian Games. Subsequently, the first-ever National Sports Policy was announced in 1984. The Ministry of Human Resource Development was set up in 1985, with the objective of integrating efforts for the development of human potential in the areas of education, women and child development, arts and culture, youth affairs, and sports through its constituent departments.

The Sports Authority of India (SAI) was established in 1984 as a registered society in pursuance of a Government of India resolution. Its main objectives include the effective and optimum utilization of various sports facilities and all matters pertaining to sports promotion and sports management. Sports and Education are an integral part of the learning process.

Therefore, it becomes necessary to include them in the evaluation of individual performance. To have a result-oriented co-ordination, the school improvement program will be enforced by taking up action in the following areas:

- Introduction of sports and games in the daily school timetable as a compulsory activity in both government and public schools/colleges/universities
- Providing the services of coaches for training
- Providing all basic infrastructure for sports and games, including equipment and other materials needed
- Encouraging evening sports activities for students and teachers
- Creation of a sports environment in every educational institute

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- The department shall endeavor to include sports as a subject at the middle school level
- Raising the teams by various boards/corporations and non-governmental organizations.

Although the central and state governments have implemented several schemes to provide rural sports infrastructure, their reach and range have been limited owing to the constraints of resources for such a vast country. Another major constraint is the gross inadequacy of trained sportspersons who can coach the local villagers to take to sports and games in any meaningful manner.

The scheme of the Rural Sports Programme was launched in 1970–1971 and is operated by SAI. The scheme lays emphasis on arranging a program of rural sports tournaments that has been launched by the central government since 1970–1971 with the twin objectives of involving a major segment of our youth in rural areas into the mainstream of the country's sports activities and also to spot and nurture sports talent.

Under the scheme, nodal voluntary sports clubs/sports centers, on recommendation of the state governments, are given 1 time grant of up to Rs. 30,000/for the purchase of consumable and non-consumable sports equipment. In case of tribal blocks, assistance up to Rs. 45,000/is given. This is followed by a grant of Rs. 5000/annum for the subsequent 2 years.

Statement of the problem

The purpose of this study was to find the attitude toward the sports of rural living males and females in Hyderabad, Telangana state.

MATERIALS AND METHODS

To achieve this purpose, 200 male and 200 female subjects were randomly selected as subjects from four villages in Hyderabad, so that a standard program for rural participation in sports can be planned in the future. The instrument used for this research project was interview schedules and questionnaires, which were prepared carefully to obtain the responses from the subjects selected from the different parts of Hyderabad. The questionnaire was prepared taking into consideration the multifarious aspects of the study.

The questionnaire contained 26 questions. The following procedures were adopted for the questioner development: 1. Pre-pilot study phase, 2. Pooling of statement, 3. Selection of statement, 4. Pilot study phase (Jury opinion), 5. Rewriting, and 6. Finalization phase.

The reliability was established using the test and retest method. The reliability of the whole test for all the statements is found using the Spearman–Brown Prophecy formula. Seven hundred questionnaire forms were given to different parts of rural areas around Hyderabad, and they were requested to provide their wholehearted cooperation for the same. The selected subjects were tested on selected criterion variables, and one-way analysis of variance was used to find out the significant differences, if any, among the male and female people for each variable separately.

Analysis of the data

The data collected from the males and females of the rural areas of Hyderabad, Telangana state, toward sports attitude were analyzed and presented in Table 1.

RESULTS

Table 1 showed that the pre-test and post-test mean and standard deviation values of males and females on sports attitude were 132.92 ± 39.54 and 131.96 ± 39.70, respectively. The obtained "F" ratio value of 0.008 was less than the required table value of 3.86 for significant at the 0.05 level of confidence with df 1 and 398. The results of the study showed that there was no significant difference between males and females of attitude toward sports in rural areas. It may be concluded from the rural areas about sports attitudes. However, the male rural people having slight advantages of sports attitudes toward the female people.

Table 1: Analysis of variance on sports attitude of rural living male and female

	Male	Female	SOV	Sum of square	Df	Mean Square	"F" Ratio
Mean	132.92	131.96	B:	12.01	1	12.01	0.008
S.D.	39.54	39.70	W:	78492.81	50	1569.86	

The required table value for significant at the 0.05 level of confidence with DF 1 and 398 is 3.86

CONCLUSION

Based on the results of the findings of the study, it was concluded that there was no significant difference between the rural living male and female on sports attitude.

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Research Article

Effect of selected yogasanas, pranayama, and meditation on resting pulse rate of high school girls

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ABSTRACT

The main purpose of the present study was to find out the effect of selected yogasanas, pranayama, and meditation on resting plus rate of high school girls. To achieve the purpose of the study, 80 girl students were selected at random from B. D. E Society School, Vijayapura, Karnataka, India. The age of the participants was 16–18 years old. The selected participants were divided into two equal groups as follows: experimental and control groups. Group 1 underwent yogasana, pranayama, and meditation training. Group 2 acted as the control group; they did not participate in any of their respective training programs, which were performed 6 days/week for a 12-week duration. The selected dependent variables, namely post-tests, were conducted on the above-said dependent variables, namely resting pulse rate, which was measured by the manual method. The difference between the pre-test and post-test was considered the effect of the respective experimental practices. The collected data were statistically analyzed using dependent – "*t*" tests and analysis of covariance. All the above statistical analysis tests were computed at the 0.05 level of significance.

Keywords: Meditation, Pranayama, Resting pulse rate, Yogasana

INTRODUCTION

The word yoga means "unity" or "oneness" and is derived from the Sanskrit word yuj, which means "to join." This unity or joining is described in spiritual terms as the union of the individual consciousness with the universal consciousness. On a more practical level, yoga is a means of balancing and harmonizing the body, mind, and emotions. This is done through the practice of asana, pranayama, mudra, bandha, shatkarma, and meditation. Moreover, it must be achieved before a union can take place with the higher reality.

The science of yoga begins to work on the outermost aspect of the personality, the physical body, which for most people is a practical and familiar starting point. When imbalance is experienced at this level, the organs, muscles, and nerves no longer function in harmony; rather, they act in opposition to each other. For instance, the endocrine system might become irregular, and the efficiency of the nervous system decreases to such an extent that a disease will manifest. Yoga aims at bringing the different bodily functions into perfect coordination so that they work for the good of the whole body.

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Prana is the total of all energy that is manifested in the universe. It is the vital force, sukshma. Breath is the external manifestation of prana, by exercising control over this gross breath. You can control the subtle prana inside. Control of prana means control of the mind. The mind cannot operate without the help of prana. It is the sukshma prana that is intimately connected with the mind. Prana is the total of all latent forces that are hidden in men and which lie everywhere around us. Heat, light, electricity, and magnetism are all manifestations of prana. Prana is related to the mind; through the mind to the will; through the will to the individual soul, and through this to the supreme being.

The seat of prana is the heart; prana is one, but it has many functions to do, hence it assumes five names according to the different functions it performs, namely, prana, apana, samana, udana, and vyana. According to the different functions they perform, they occupy certain places in the body.

Meditation is a general term applied to methods of steadying, quieting, or opening the mind to alter states of consciousness.

Most yoga aims for the suspension of thought and silencing of the mind's agitation. Attention is a keyword in describing the achievement of a meditative state. Although some schools consider meditation to be a means of achieving the higher knowledge or heightened consciousness, the aim of meditation may also be at the less exalted, but certainly just as valuable, level of relaxation and mental hygiene. Meditation means a sense of withdrawal and concentration sustained into contemplation to achieve a super-conscious state of intuitive realization of the identity of the individual soul or spirit and the cosmic soul or spirit.

METHODOLOGY

To achieve the purpose of this study, 80 girl students were randomly selected as subjects from the B. D. E. Society School, Vijayapura, Karnataka, India. Their age was 16–18 years. The selected participants were randomly divided into two groups: "A" yogasanas, pranayama, and meditation ($n = 40$), and "B" acted as control group ($n = 40$). Group "A" underwent yogasanas, pranayama, and meditation practices for 6 days/week. However, control group was not exposed to any specific training, but they participated in their regular schedule. Resting rate was assessed by the radial pulse artery manual count method. The pre- and post-tests data were collected on selected criterion variable scores, which were statistically examined by the dependent "*t*" test and analysis of covariance. The level of significance was fixed at the 0.05 level of confidence, which was considered appropriate.

RESULTS OF THE STUDY

Table 1 shows the pre-test means scores of the pulse rate level of control and experimental groups of high school girl students. It is observed that the mean scores of the pre-test of control and experimental groups of high school girl students are 74.8750 and 78.2000, and their standard deviations are 6.53271 and 12.43073, respectively. The obtained "F" ratio value is (F = 2.243 1, 78, α =0.05) at 2.243 5% level of significance, which is less than the table value (F = 4.0), hence the null hypothesis is accepted, it can be concluded that the pulse rate level between the experimental group and control group is found to be almost similar.

Further, it is observed that the mean scores of the post-test of control and experimental groups of high school girl students are 75.9250 and 70.0000, and their standard deviations are 7.20181 and 12.10848, respectively. The obtained "F" ratio value is (F = 7.07571, 78, α =0.05) at 7.075 5% level of significance, which is more than the table value (F = 4.0), hence the null hypothesis is rejected, and the alternative hypothesis is accepted. It can be concluded that there is a significant difference found between the experimental group and the control group with respect to the pulse rate level of high school girl students. This indicates that the pulse rate level is higher among the control group when compared to the experimental group. Finally, it can be revealed that yogasanas, pranayama, and meditation training have had a significant influence on the control of pulse rate level of the high school girl students.

The adjusted post-test means scores on pulse rate of the control and the experimental groups are 76.381 and 69.399, respectively. The obtained "F" ratio value is (F = 10.408 1, 76, α = 0.05), 10.408 at 5% level of significance, which is much higher than the table value (F = 4.0), hence the null hypothesis is rejected, and the alternative hypothesis is accepted. It can be concluded that there is a significant difference between the experimental group and the control group with respect to the pulse rate level of high school girl students.

Figure 1 gives a clear picture of the adjusted means of two training groups. Thus, it is inferred that yogasanas, pranayama, and meditation training are more effective in decreasing the pulse rate among the subjects in the experimental group compared to the control group.

DISCUSSION ON FINDINGS

The result of this study reveals that there is a significant difference in resting pulse rate between the pre-test and the

Table 1: The analysis of covariance for pre-test and post-test on the resting pulse rate of control group and experimental group of high school girls

Type of test	Control group	Experimental group	Source of variance	Sum of the squares	df	Mean square	F-ratio
Pre-test mean	74.8750	78.2000	Between	221.113	1	221.113	2.243
SD	6.53271	12.43073	Within	7690.775	78	98.600	
Post-test mean	75.9250	70.0000	Between	702.112	1	702.112	7.075
SD	7.20181	12.10848	Within	7740.775	78	99.241	
Adjusted post-test mean	76.381	69.399	Between	935.237	1	935.237	10.408
			Within	6829.071	76	89.856	

*significance α=0.05, Table value=4.0. SD: Standard deviation

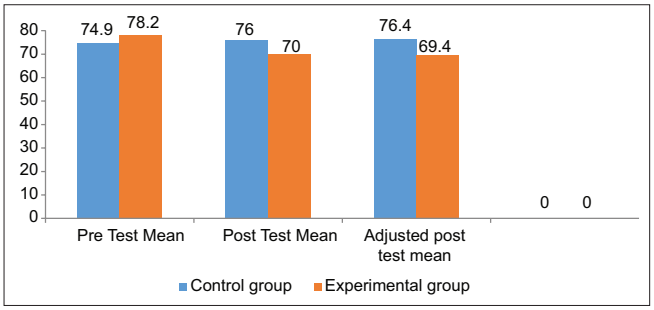

Figure 1: The graphical presentation of the resting pulse rate of pre-test, post-test, and adjusted post-test means of control group and experimental group

post-test of the experimental and the control groups. There is a significant difference in the adjusted post-test mean due to the 12 weeks of the training program.

The results, by and large, were in conformity with the findings of Selvaraja *et al*. (2018), Ramesh *et al*. (2010), and Arungiri and Krishan.

CONCLUSIONS

The resting pulse rate was decreased after the training when compared with the control group.

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Research Article

Coping strategies between physical education and sports authority of India female athletes: A comparative study

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ABSTRACT

Purpose: The purpose of this research was to examine the coping strategies employed by physical education students and female athletes from the Sports Authority of India (SAI), Banaras Hindu University (BHU), to address problem-focused coping and emotion-focused coping. **Methods:** A total of 30 female subjects, consisting of 15 physical education students and 15 SAI athletes, in different age groups. Using a random sample technique, participants were selected from the physical education age group (20–24 years) and the SAI athletes age group (16–20 years) according to academic record. SAI, athletes subject was residing in SAI, BHU Campus with a fixed schedule, and some physical education subjects were residing in hostel, hence having a different environment and schedule were chosen for the study. Prof. A.K. Srivastava of BHU 's Department of Psychology established a set of standardized coping mechanisms. The test-retest score for the questionnaire with (n = 79) is stated to be 0.92, which is relatively high. Despite measuring only those for which it was designed, the test is axiomatically valid. **Results:** The study used some descriptive statistics to assess the stress levels and coping techniques of female SAI BHU and physical education participants in relation to different sports. And to compare the coping strategies among female SAI BHU athletes and physical education athletes in relation to different games at different ages, the t-test was used. The level of significance was set at 0.05. **Conclusion:** The statistical analysis of results revealed that there was no significant difference in behavioral approach coping strategies, coping approach coping strategies, cognitive behavioral approach coping strategies, behavioral avoidance coping strategies, and cognitive avoidance coping strategies.

Keywords: Coping strategies, Sports psychology, Stress

INTRODUCTION

Sports psychology is a sub-discipline of psychology that focuses on physical education and sports. It has only been acknowledged for three decades. It is one of the primary subjects covered in athletic performance and sports psychology (Sanatakaran, 1997). Sports psychology is a science that uses psychological concepts in an athletic or fitness context. These ideas are frequently used to improve performance. The goal of a true sports psychologist is to assist each athlete in realizing their full potential. The goal of the fascinating field of sports psychology is to improve human enrichment through social psychology as well as athletic performance (Cox, Richard H.)

The word "stress" is frequently used to characterize uncomfortable emotions like tension or tiredness, which are typically brought on by a demanding workload. In everyday life, stress is a normal occurrence. An individual's motivation, performance, contentment, and personal fulfillment at work can all be positively impacted by it (Mathewman *et al*., 2009). To put it another way, stress is defined as any strain that surpasses a person's capacity to sustain emotional, psychological, or physiological stability (Furnham, 2005). According to Hans Selye (1979), stress is any internal or external event that could upset an organism's equilibrium. To put it another way, stress is anything that modifies our mental, emotional, behavioral, or physical states in response to different environmental stimuli. The majority of well-known

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definitions highlight stress as "any factor that threatens an individual's health or harms the functioning of the body" (Oxford Medical Publications, 1985), notwithstanding its widespread view.

Coping strategies buffer people from psychological damage brought on by challenging life events (Pearlin and Schooler, 1978). Strategies, tactics, reactions, thoughts, or behaviors can all be used to characterize coping. Actual coping is a phenomenon that can be seen through observation or reflection, and it encompasses both overt and internal behaviors. Folkman and Lazarus (1984) described coping as an athlete's behavioral and cognitive strategies for handling the internal and external stress that comes with training. According to research, both sports performance and personal satisfaction are negatively impacted by an inability to adequately manage stress (Besharat, 2004). According to research, both sports performance and personal satisfaction are negatively impacted by an inability to adequately manage stress (Besharat, 2004). Athletes use a variety of coping mechanisms:

- Emotion-focused stress management strategy: This method focuses the individual's attention on suppressing the unpleasant feelings brought on by stress. When the distressing event is thought to be inevitable, people frequently employ this tactic (Davari, 2007).
- Problem-focused stress management strategy: In this approach, the person concentrates on the issue or circumstance that arose, attempting to modify it and prevent it in the future.
- Avoidance-oriented stress management strategy: This method involves avoiding the stressor, minimizing, neglecting, and establishing psychological distance, asking for assistance from others, or using other activities as a coping mechanism (Endler and Parker, 2005).
- Stress management technique based on intuition (enlightenment): By depending on God, hope, optimism, and faith, the individual develops coping mechanisms (Khodayarifard, 2011).

These tactics encompass all behavioral and cognitive attempts to address, mitigate, and balance the detrimental impacts and repercussions of stress. Many models and techniques for managing stress are now acknowledged. These models have produced many helpful theoretical underpinnings for researching various aspects of stress, cognitive assessment of stress, sources of support for coping strategies, such as environmental factors, individual differences, and the function of any strategy. However, these models are highly varied and occasionally completely individual.

Statement of Problem

The purpose of the study is to compare stress coping strategies among the women athletes of different age groups, hence stated as: "*A Comparative study of coping strategies between female physical education students and sports authority of India Female athletes.*"

Objective of the Study

The objective of this study is to compare the stress-reduction techniques used by female athletes and physical education students at Banaras Hindu University (BHU) University, sports authority of India (SAI).

Hypothesis

It was hypothesized that there would be a significant difference in stress coping strategies between SAI BHU, female athletes, and female physical education students, BHU.

Delimitation

- Only 15 SAI female athletes and 15 students from the BHU Department of Physical Education were included in the study
- In addition, only SAI female players between the ages of 13 and 18 and physical education students between the ages of 18 and 23 were included in the study.
- Additionally, the study was confined to five psychological characteristics, which are as follows:

1. Active/approach coping (problem-focused coping)
    - Behavioral-approach coping strategies
    - Cognitive-approach coping strategies
    - Cognitive-behavioral-approach coping strategies

2. Avoidance coping (emotion-focused coping)
    - Behavioral-avoidance coping strategies
    - Cognitive-avoidance coping strategies.

Limitation

The study's limits will include habits, family history, lifestyle, diet, social and environmental influences, and any motivational strategies employed by the coach that might affect the findings.

Participants

Thirty female participants were chosen from the BHU in Varanasi. The subjects (15 from each center) were selected from BHU's SAI and Department of Physical Education. The subjects were 16–20 years old for the SAI, BHU, and 20–24 years old for the female physical education students.

Variables

To analyses the data following variables of coping strategies to be used for the present study.

1. Active/approach coping (problem-focused coping)
    - Behavioral-approach coping strategies
    - Cognitive-approach coping strategies
    - Cognitive-behavioral-approach coping strategies.

2. Avoidance coping (emotion-focused coping)
    - Behavioral-avoidance coping strategies
    - Coping-avoidance coping strategies.

Criterion Measures

The coping strategies scale has 50 items, to be rated on a five-point scale, describing varieties of coping behavior following five major categories of coping strategies based on the combinations of "operation" and "orientation" of the coping behavior.

Scoring

Response-categories	Score
Never	0
Rarely	1
Sometimes	2
Most of the times	3
Almost always	4

The scores on all 50 items should not be added together in order to evaluate the subject's efficiency or coping mechanisms. Instead, each of the five types of coping mechanisms needs to be handled independently. To get distinct scores for each of the five coping mechanisms, to determine the degree of the subject's propensity for approach and avoidance coping behavior, scores on the items in two categories of avoidance coping strategies (i.e., behavioral –avoidance; cognitive – avoidance) and three categories of approach coping strategies (i.e., behavioral – approach; cognitive-approach; cognitive – behavioral – approach) may be combined.

	Level of coping		
	Low/ deficient	Moderate	High/ efficient
Approach-behavioral	0–29	30–45	46–60
Approach-cognitive	0–11	12–18	19–24
Approach-cognitive-behavioral	0–15	16–24	25–32
Avoidance-behavioral	0–27	28–42	43–56
Avoidance-cognitive	0–13	14–21	22–28

The scores obtained on five sub-scales of the coping strategies scale may be categorized as per the following norms to know the extent of coping.

Since the norms have yet not been prepared on a large sample from diverse populations, the users or researchers are suggested to prepare the norms for their study on the basis the scores of their own samples as per the guidelines provided below:

Score	Level of coping
Above median	Efficient/high coping
Below median	Deficient/low
25th percentile or below	Deficient/low
Between 26th and 75th percentile	Moderate coping
76th percentile or above	Efficient/high coping

High scores on avoidance coping strategies would indicate deficient or dysfunctional coping, and low score would indicate efficient or functional coping. Avoidance coping strategies might bring immediate and short-term relief. However, in long term, they are likely to add to the stress of the person, and result in psychological strain and pathologies in some cases

Data Collection

The standardized coping strategies scale, created by Prof. A. K. Srivastava of the Department of Psychology at BHU, was used to gather data from both groups, which consisted of 50 items.

Statistical Analysis

To compare coping strategies between the two groups, descriptive statistics and independent *t*-tests were used to analyze the responses. The level of significance was set at 0.05.

FINDINGS

Table 1 revealed that there was no significant difference in SAI, BHU, and physical education students in relation to behavioral approach coping strategies, as the obtained "*t*" ratio was 0.91, which was a lower value than 2.048, required for "*t*" ratio to be significant at 0.05 level with 28° of freedom.

Table 2 revealed that there was no significant difference in SAI, BHU, and physical education students in relation to cognitive approach coping strategies, as the obtained "*t*" ratio was 0.83, which was a lower value than 2.048, required for "*t*" ratio to be significant at the 0.05 level with 28° of freedom.

Table 3 revealed that there was no significant difference in Sports Authority of India, BHU, and physical education students in relation to cognitive behavioral approach coping strategies, as the obtained "*t*" ratio was 0.500, which was a lower value than 2.048, required for "*t*" ratio to be significant at the 0.05 level with 28° of freedom.

Table 4 revealed that there was no significant difference in SAI, BHU and physical education students in relation to behavioral avoidance coping strategies, as the obtained "*t*" ratio was 0.51, which was a lower value than 2.048, required for "*t*" ratio to be significant at the 0.05 level with 28° of freedom.

Table 5 revealed that there was no significant difference in SAI, BHU, and physical education students in relation to cognitive avoidance coping strategies, as the obtained "*t*" ratio was 0.29, which was a lower value than 2.048, required for "*t*" ratio to be significant at 0.05 level with 28° of freedom.

DISCUSSION OF FINDING

Regarding problem-focused coping techniques (behavioral coping strategies, approach coping strategies, and cognitive-behavioral coping strategies), the data analysis revealed no significant difference between SAI athletes, BHU athletes, and physical education athletes. This could be explained by the fact that stressful events can occasionally improve or worsen athletic performance in sports or play. A study on the consistency of coping style and scenario appraisal among Australian certified basketball referees was carried out by

Table 1: Mean, standard deviation, and *t*-test of female SAI, BHU, and female physical education students in relation to behavioral approach coping strategies

Group	*n*	Mean	Standard deviation	"*t*" ratio
SAI BHU	15	34.4	5.03	0.91
Physical education students	15	34.6	5.21	

*Significant at 0.05 level of significance, "*t*" value needed to be significance at 0.05 level with 28 degree of freedom is 2.04. SAI: Sports Authority of India, BHU: Banaras Hindu University

Table 2: Mean, standard deviation, and *t*-test of female SAI, BHU, and female physical education students in relation to cognitive approach coping strategies

Group	*n*	Mean	Standard deviation	"*t*" ratio
SAI BHU	15	13.33	2.86	0.83
Physical education students	15	13.6	3.61	

*Significant at 0.05 level of significance, "*t*" value needed to be significance at. 05 level with 28° of freedom is 2.048. SAI: Sports Authority of India, BHU: Banaras Hindu University

Table 3: Mean, standard deviation, and *t*-test of female SAI, BHU, and female physical education students in relation to cognitive behavioral approach coping strategies

Group	*n*	Mean	Standard deviation	"*t*" ratio
SAI BHU	15	19.53	4.28	0.500
Physical education students	15	20.8	5.46	

*Significant at 0.05 level of significance. "*t*" value needed to be significance at 0.05 level with 28° of freedom is 2.048. SAI: Sports authority of India, BHU: Banaras Hindu University

Table 4: Mean, standard deviation, and *t*-test of female SAI, BHU, and female physical education students in relation to behavioral avoidance coping strategies

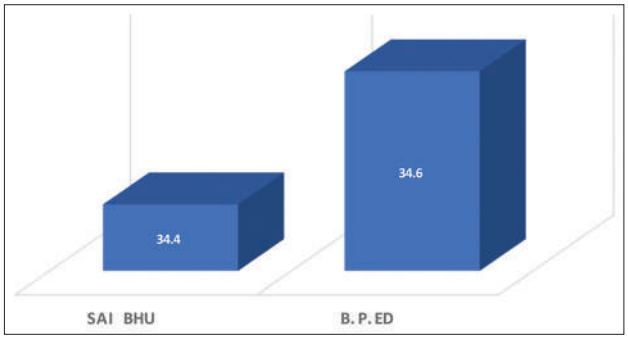
Group	*n*	Mean	Standard deviation	"*t*" ratio
SAI, BHU	15	20.86	3.73	0.51
Physical education students	15	21.93	4.68	

*Significant at 0.05 level of significance, "*t*" value needed to be significance at 0.05 level with 28° of freedom is 2.048. SAI: Sports authority of India, BHU: Banaras Hindu University

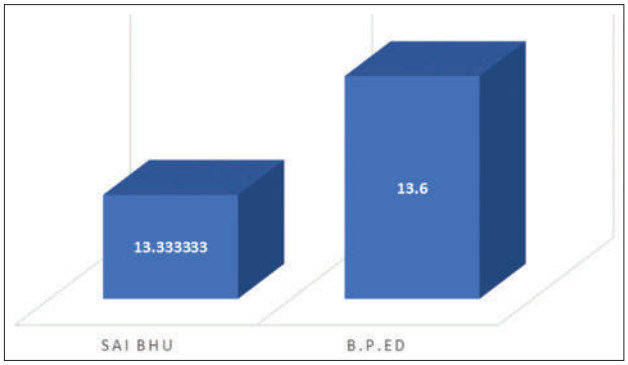
Table 5: Mean, standard deviation, and *t*-test of female SAI, BHU, and female physical education students in relation to cognitive avoidance coping strategies

Group	*n*	Mean	Standard deviation	"*t*" ratio
SAI BHU athletes	15	15.33	3.24	0.298
Physical education students	15	14	3.43	

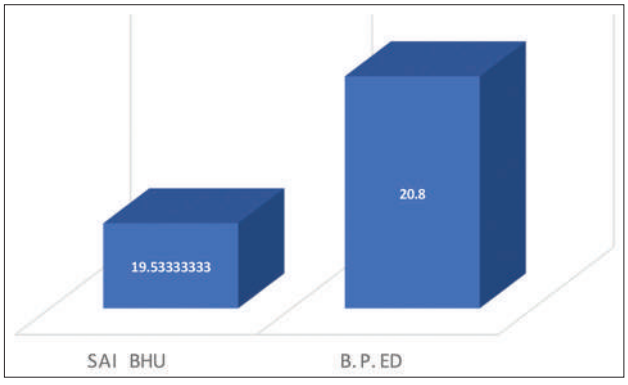
*Significant at 0.05 level of significance. "*t*" value needed to be significance at 0.05 level with 28° of freedom is 2.048. SAI: Sports Authority of India, BHU: Banaras Hindu University



Graph 1: The graphical representation of the mean value of sports authority of India, Banaras Hindu University, and physical education students in relation to behavioral approach coping strategies

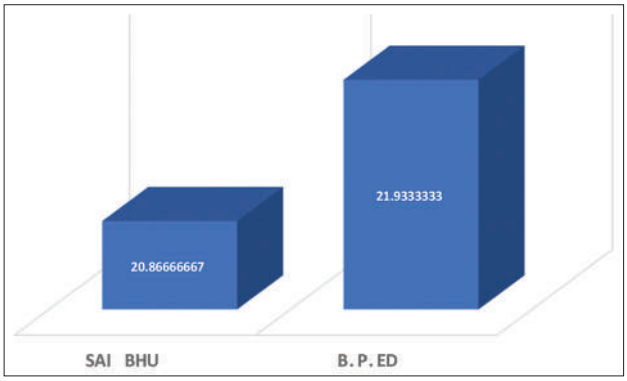


Graph 2: The graphical representation of mean value of sports authority of India, Banaras Hindu University, and physical education students in relation to cognitive approach coping strategies

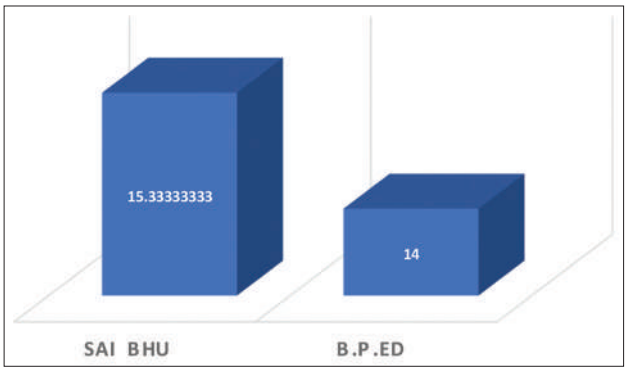


Graph 3: The graphical representation of mean value of sports authority of India, Banaras Hindu University, and physical education students in relation to cognitive behavioral approach coping strategies

Angela Kaissidis-Rodulines in 1997. According to the study's findings, there were notable differences between mid-level and high-level basketball players' coping strategies and stress perceptions. The results of this study were not corroborated by the research done by Angela Kaissidis-Rodulines (1997). The study's findings suggest that, in comparison to SAI athletes, physical education athletes may exhibit less intense



Graph 4: The graphical representation of the mean value of sports authority of India, Banaras Hindu University, and physical education students in relation to behavioral avoidance coping strategies



Graph 5: The graphical representation of mean value of sports authority of India, Banaras Hindu University, and physical education students in relation to cognitive avoidance coping strategies

competition, performance-seeking behavior, aggressiveness, hurry, impatience, restlessness, Kaissidis, tense facial muscles, and a sense of time pressure. The findings also demonstrated that players in physical education used greater behavioral, cognitive, and cognitive-behavioral coping mechanisms. In addition, the current study discovered that female athletes in SAI, BHU, and physical education did not significantly differ in emotion-focused coping (behavioral avoidance methods and cognitive avoidance strategies). This could be a result of athletes in Physical Education, BHU, and SAI BHU having comparable expectations for reaching objectives.

DISCUSSION OF HYPOTHESIS

Since there was no discernible difference between BHU SAI FEMALE and female physical education athletes, the previously proposed hypothesis that there was a significant difference in coping strategies – behavioral approach coping strategies, cognitive approach coping strategies, cognitive-behavioral approach coping strategies, behavioral avoidance strategies, and cognitive avoidance strategies – is rejected.

CONCLUSION

The following conclusions were reached based on the analysis and study findings: Behavioral coping methods, cognitive coping strategies, behavioral coping strategies in response to stress, behavioral avoidance strategies, and cognitive avoidance techniques did not significantly differ.

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Research Article

Sports-specific training effect on dribbling skill of male football players

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ABSTRACT

Purpose: The purpose of the study was to find out the sports-specific training effect on the dribbling skill of male Football players. **Methods:** For the purpose of the study, 20 male subjects of LNIPE Football players, age range from 18 to 24 years, who had the level of participation at least University and State Competitions were randomly selected. The selected 20 players were randomly divided into an experimental group ($n = 10$, EG) who underwent sports-specific training and a control group ($n = 10$, CG) for the normal general training. Descriptive Statistics and analysis of covariance test were used to analyze the data, with a significance level of 0.05. **Results:** The mean and standard deviation for the pre-test and the post-test data were (32.1 ± 0.934, 32.1 ± 1.02) of control group and (32 ± 0.745, 31.5 ± 0.928) of experimental group, respectively. It indicated that the calculated F-ratio value is 17.6, which is higher than the tabulated f-value 4.45. Hence, it showed significance. **Conclusion:** The results of sports specific training program have shown a significant improvement. The ability of the dribbling skill was better for the experimental group when compared with the control group. It can be concluded that the 6 weeks of sports-specific training program thus bring improvement in the performance of dribbling ability in the football players.

Keywords: Sports-specific training, Dribbling skills, and standardized skill test

INTRODUCTION

Soccer or Football is a global sport that requires a high degree of technical, tactical, physiological, and psychological preparedness. Among the numerous technical skills essential for performance, dribbling constitutes the fundamental core skill that determines effectiveness to the outcome of the match. Skill-specific training programs have grown in importance within sports science as an efficient and effective means of enhancing athlete dribbling performance by focusing on precision, moving with the ball under our control, decision-making, agility, creativity, and improvisation. Hence, this targeted and structured training program is especially relevant at the amateur level, where players are in critical stages of developing the foundational skills that will determine their performance in higher levels of play. Despite widespread use of general training, which may emphasize endurance, overall strength, or agility, skill-specific training hones in on the exact techniques necessary for success in a particular sport limited empirical evidence exists regarding the direct effects of structured, skill-specific training on quantifying the improvement of performance outcomes. This study addresses this gap by examining how targeted training in dribbling affects technical proficiency among male football players.

In the competitive field of soccer, the ability to execute precise, skillful dribbles and creativity is crucial. However, there is a need to understand the direct effects of targeted, skill-specific training on this variable. The problem of this study was to address the lack of empirical evidence on how specialized training in dribbling affects performance. The findings of this study could be informed that whether sport-specific training yields measurable improvements in this core fundamental area, thus enhancing players' effectiveness on the field.

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Statement of the Problem

Therefore, the research problem has been stated as, "*Sports Specific Training Effect on Dribbling Skill of Male Football Players.*"

Objectives of the Study

The primary objective was to assess the impact of sports-specific training on the dribbling ability of male football players.

Hypothesis of the Study

H_0: It was hypothesized that sports-specific training would have no effect on dribbling skill.

Delimitations

The study was delimited to the subject's age ranges from 18 to 24 years, and the training was spanned for only 6 weeks, with three sessions per week, and the test was measured using a standardized test (Mor-Christian General Soccer Ability Test), and the study would be exclusively focused on dribbling skill only.

Limitations

The study was limited to the lifestyle and habits of the participants. Moreover, it is also limited to the motivation and psychological factors that could also affect in the study. No effort was made to regulate elements like air resistance, light intensity, temperature, and environment during the training and testing phase.

Significance of the Study

This study was significant for several reasons, that this study would be provided an evidence-based analysis of the effect of targeted skill-specific training on core soccer ability. The skill-specific training showed measurable improvements, it would be supported the inclusion of such programs in soccer training, offering an alternative to traditional training methods, and it would be served as a resource for coaches/physical education experts who wish to optimize their training regimens for greater efficiency and effectiveness, particularly at the developmental level.

Selection of the Subjects

Twenty male subjects were randomly selected from the LNIPE Football players. The age ranges from 18 to 24 years, and they had participated at least University Games and State Competitions.

Experimental Design

Twenty players were divided into two equal groups for the pre- and post-test random group design and were categorized into the experimental group ($n = 10$, EG), who received sports-specific training, and the control group ($n = 10$, CG) for normal general training.

Selection of Variables

The dependent (dribbling skill) and independent (sports-specific training) variables were selected to observing the selected sports-specific training effects owing to 6 weeks training interventions.

Selection of the Test

To determine the effect of sport-specific skills training on dribbling skill variable among male football players, Mor-Christian General Soccer Ability Skill test was used and it was developed in 1979 by Mor and Christian. It was tested on 45 male college students to determine the Dribbling ability of the players. This dribbling skill performance would be tested with a standardized skill test protocol, and units of measurement would be in seconds ($1/10^{th}$).

Training Schedule – Experimental Group

The experimental group underwent sports-specific training as per the stipulated training approach. During the training period of 6 weeks, 1–2 weeks, the players executed the selected dribbling drills with one repetition of one set. For 3–4 weeks, the players executed the selected dribbling drills with two repetitions of one set. For 5–6 weeks, the players executed the selected dribbling drills with three repetitions of one set for the duration of 1 hr per session and 3 sessions a week.

Administration of the Test

Dribbling skill test

- Purpose: To assess the player's dribbling ability.
- Equipment: A score card, a measuring tape, cones (17), a stopwatch, and footballs.
- Preparation: A 20-yard-diameter round course would be measured and marked, twelve 18-inch cones would be placed around the circle at 5-yard intervals, and a 3-foot starting line would be drawn perpendicular to the circle's outer boundary as shown in Figure 1.

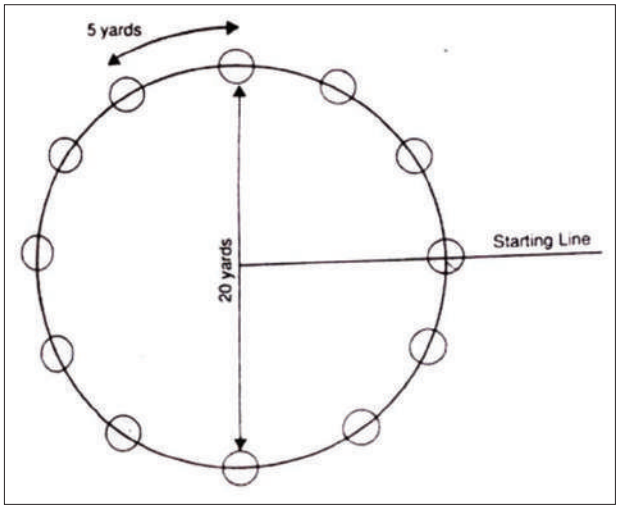

Figure 1: Dribbling

- Directions: When the "go" signal is given, the player starts dribbling the ball from the starting line around the course. The player dribbles the ball between the cones in the zigzag manner and returning back to the starting line. The time taken by players to complete the test should be noted. The first and second attempts should be in anticlockwise direction, whereas the third attempt should be in the player's preferred direction. Three trials would be given to each player.
- Scoring: The total time of the best two trials is the final score.

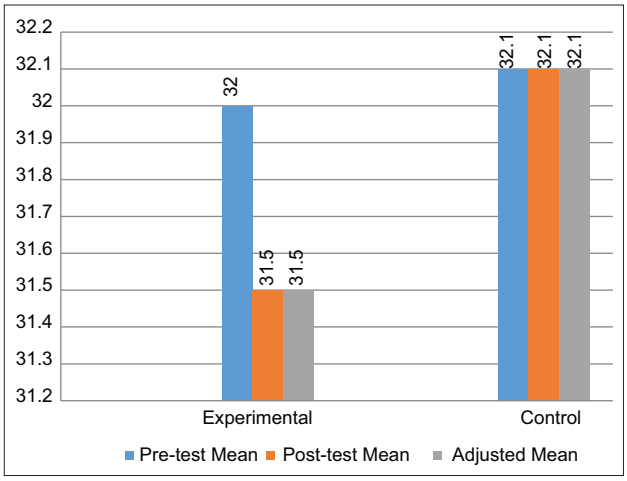

Figure 2: The graphical representation of adjusted post-test mean values

Table 1: Descriptive statistics on dribbling skill of the control group and experiment group

Groups	Test	Mean	Standard deviation
Control	Pre-test	32.1	0.934
	Post-test	32.1	1.02
Experimental	Pre-test	32	0.745
	Post-test	31.5	0.928

Collection of Data

The selected dribbling skill variable would be measured, and data would be collected as per the standard procedures and instructions available in the aforementioned literature in textbooks, journals, thesis, and the data in respect of male football players of LNIPE.

Statistical Techniques

Descriptive statistics would be calculated to summarize the measures of central tendency and measure of dispersion. Analysis of covariance (ANCOVA) test would be used to determine the effects of sports-specific skill training on the dribbling skill variable among male football players. The level of significance for the test would be set at 0.05. Analysis of data would be done using statistical software, the Statistical Package for the Social Sciences (2020 version).

RESULTS AND DISCUSSION

Pre-test was conducted and collected the data from the selected players for both groups. After that, the subjects in the experimental group were underwent for the specific training program for 1 hr per session, three sessions a week, and for a duration of 6 weeks. After the training intermission again, post-test was conducted, and the data were collected for both groups. The pre- and post-test data were analyzed with statistical tools (descriptive statistics and ANCOVA).

After 6 weeks of training, the statistical technique (ANCOVA) was applied to assess whether the players' dribbling skills had significantly improved as a result of the sports-specific training. The following tables showed the analysis and presentation of the impact of sports-specific based training (Experimental group) on male football players' dribbling abilities.

An examination of Table 1 showed that the mean and standard deviation for the pre-test and the post-test data on dribbling

Table 2: Summary of analysis of covariance for the data on dribbling skill between control and experiment groups

Source of variance	Sum of square	Df	Mean square	F-ratio	*P*-value
Between	2.06	1	2.056	17.6	<0.001*
Within	1.99	17	0.117		

*Significant at 0.05 level

Table 3: Description of pre-test means, post-test means, and adjusted means of dribbling skill performance of experiment and control group

Groups	Mean (pre-test)	Mean (post-test)	Adjusted mean
Experimental	32	31.5	31.5
Control	32.1	32.1	32.1

skill (32.1 ± 0.934, 32.1 ± 1.02) and (32 ± 0.745, 31.5 ± 0.928) of the control group and experimental group, respectively.

Table 2 showed that the calculated value of F-ratio (17.6) is higher than the tabulated f-value (4.45) with the degree of freedom (1 and 17) at the 0.05 level of significance. Hence, it indicated that there was a significant difference between the experimental and control groups.

Table 3 showed that pre-test and post-test means are (32), (31.5), and (32.1) and (32.1) of the experimental and control group, respectively. The adjusted means are (31.5) and (32.1) of the experimental group and control group, respectively.

The results of adjusted post-test means values are shown in Figure 2.

Findings and Analysis of Findings

The result of the dribbling skill evidently substantiate that a significant difference was found between control and experimental groups on dribbling skill after the 6 weeks of training interventions, and after the statistical analysis, the training group had greatly enhanced their dribbling proficiency from the initial state to the post-interventions. Both groups have significantly altered the dribbling skill performance from pre (32.1 ± 0.934) to post (32.1 ± 1.02) for the control group and sports-specific training group, that is, the experimental group, from pre (32 ± 0.745) to post (31.5 ± 0.928). Hence, this study's findings showed that, in comparison to the control group, the experimental group's quality of dribbling ability performance improved considerably during the 6-week training period.

Testing of Hypotheses

To examine the selected sports-specific training effect on dribbling skill of male football players hypothesis was formulated as sports-specific training would have no effect on the dribbling skill of the players. To test this hypothesis, ANCOVA was applied to determine the effect of sports-specific skill training, and obtained that the calculated F-ratio value 17.6, which is found to be greater than the tabulated value 4.45. Hence, selected sports-specific training significantly improved the skill performance variables, namely, dribbling ability among male football players. Hence, the hypothesis was rejected based on the findings of the current study.

CONCLUSION

The present study's findings contributed to the following conclusions that the dribbling skill of the players was improved owing to the training group, that is, the experimental group, when compared with the control group; however, the improvement could be seen in favor on that group who underwent sports-specific based training. It can be concluded the 6 weeks of sports-specific training program thus bring improvement in the performance of dribbling ability in the male football players. Hence, the hypothesis is rejected.

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Research Article

A comparative study of depression, anxiety, and stress-21 between individual and team athletes

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ABSTRACT

Purpose: The study aimed to investigate the significant difference in the depression, anxiety, and stress scale-21 (DASS-21) between individual and team athletes. **Methods:** A total of 30 female subjects between 18 and 23 years of age were selected for the study. Fifteen athletes from both individual and team sports who had participated in national-level tournaments were randomly selected. The data collection was carried out for both groups on DASS-21. The data obtained were statistically analyzed using an independent *t*-test to determine the differences between the two groups, and the level of significance was set at 0.05. **Results:** The mean and standard deviation of depression between individual and team athletes were 6.20 ± 2.98 and 7.20 ± 1.85, respectively, and the computed difference was not statistically significant, $t = -1.10$. The mean and standard deviation found in anxiety between individual and team athletes were 8.26 ± 2.89 and 7.33 ± 2.60, respectively. There was no significant difference found, as calculated $t = 0.92$. The mean and standard deviation of stress between individual and team athletes were 7.80 ± 3.36 and 10.33 ± 2.87, respectively, and there was a significant difference found as calculated $t = -2.21$. **Conclusion:** The result of the study concluded that there were extreme severities of depression in athletes of both team and individual games. Likewise, there were extreme severities of anxiety in both individual and team athletes. The study also concluded that there were moderate severities of stress; it was moderate in individual athletes and normal in team game athletes.

Keywords: Anxiety and stress, Depression, Individual athletes and team athletes

INTRODUCTION

Games and sports play a vital role in our lives. Although they promote general well-being and are advantageous for social, mental, and physical development, they seem likely to cause stress. A lot of athletes deal with stress and anxiety daily.

Stress is frequently seen as a drawback, but it can actually be advantageous and serve to inspire athletes. According to Cohn, the appropriate levels of stress aid in preparation, concentration, and peak performance. On the other hand, excessive stress can lead to performance anxiety and prevent you from playing calmly, confidently, and intently during a competition. Your stress level needs to be both productive and controllable if you want to perform at your best.

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Anxiety is said to be more prevalent in a competitive sports environment. Anxiety is not always a bad thing because it can make it easier for players to concentrate and be aware of what they are doing. It has been noted that participants experience anxiety when engaging in different sports. It was found that most young or inexperienced players experience anxiety, which negatively impacts their performance. It is advised that the player's anxiety level be neither excessively high nor extremely low. Anxiety is not always harmful when used in moderation. A healthy amount of anxiety can help athletes perform better.

Depression is a prevalent mental illness. The disorder is thought to affect 5% of adults worldwide. Persistent melancholy and a lack of enjoyment or interest in once fulfilling or joyful activities are its hallmarks. Anxiety and depression are serious conditions that can be treated. Despite having distinct causes, the two also exhibit similar symptoms, such as anxiety and irritability.

Sportsmen are seen to be significant mental health markers for stress, anxiety, and depression. Unfortunately, psychological morbidity will rise and have unfavorable effects on people's lives and careers if emotional illnesses are not identified and treated. Most research has been conducted on adults on the depression, anxiety, and stress scale-21 (DASS-21). This study was therefore done to evaluate, for sports persons, the prevalence of DASS-21.

Statement of the Problem

The purpose of this research was to find out the comparative study on DASS-21 between individual and team athletes.

Objective

To compare the DASS-21 between individual and team game athletes.

Hypothesis

It was hypothesized that there might be a significant difference in depression between individual and team athletes. It was hypothesized that there might be a significant difference in anxiety between individual and team athletes. It was hypothesized that there might be a significant difference in stress between individual and team athletes.

Delimitation

The research was delimited to 30 athletes, 15 athletes each from individual and team, who have participated at the national level. The ages of the subjects ranged from 18 to 23 years. The statistical analysis was limited to DASS-21 for collecting data, and the study's boundaries were limited to only female athletes.

Limitation

The daily practice, physical activities, and the emotional stages of the athletes were not controlled. There was no control over the dietary habits of the selected subjects. Errors in the measurements during the collection of data were recognized as the study's drawback.

Participants

A total of 30 subjects between 18 and 23 years of age were selected for the study. Fifteen athletes, each from individual and team, who had participated in the national level competition, were selected using a random sampling method. The athletes gave their consent to be a part of this study voluntarily after an explanation of all the methods and goals of the study.

Variables

The DASS-21 test was used to understand the variations between individual and team athletes by comparison of the depression, anxiety, and stress questionnaire.

Criterion Measures

DASS-21 is a set of three self-report scales. There are seven items on each of the three scales, grouped into subscales with comparable contents. Recommended cutoff scores for conventional severity labels (normal, moderate, and severe) are as follows:

	Depression	Anxiety	Stress
Normal	0–9	0–7	0–14
Mild	10–13	8–9	15–18
Moderate	14–20	10–14	19–25
Severe	21–27	15–19	26–33
Extremely severe	28+	20+	34+

Lovibond and Lovibond (1995). Manual for the Depression Anxiety Stress Scales (2nd Ed.) Sydney: Psychology Foundation.

Data Collection

The data collection was carried out for both groups using the DASS-21 test. The research was based on responses to the questionnaire of the sample of individual and team athletes.

Statistical Analysis

The statistical analysis of data was carried out by administering the independent *t*-test. The level of significance is set at 0.05 to test the hypothesis.

Findings

Table 1 displays the mean comparison of depression between individual and team athletes. The individual and team athletes have a mean difference of −1.10, a *t*-value of −1.10, and a significant $P = 2.80$. Since the obtained $P > 0.05$. There is no significant difference between the two groups.

	Depression
Individual athletes	6.2
Team athletes	7.2

Scores of depression levels between individual and team athletes.

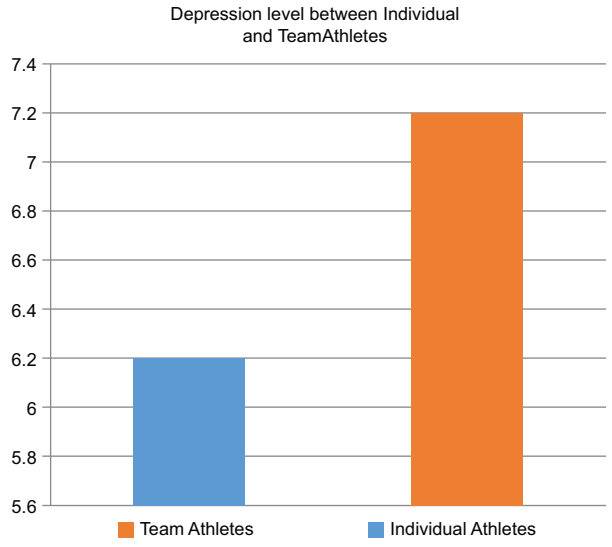


Table 2 displays the mean comparison of anxiety levels between individual and team athletes. The individual and team athletes have a mean difference of 0.93, a *t*-value of 0.92, and a significant $P = 0.36$. Since the obtained $P > 0.05$. There is no significant difference between the two groups.

Scores of anxiety levels between individual and team athletes

Anxiety	
Individual athletes	8.26
Team athletes	7.33

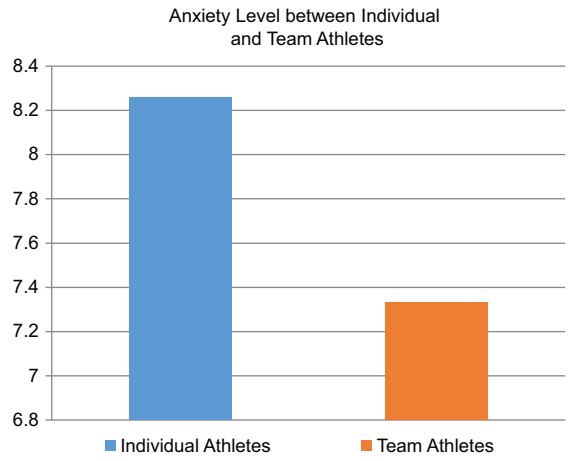


Table 3 displays the mean comparison of stress levels between individual and team athletes. The individual and team athletes have a mean difference of −2.53, a *t*-value of −2.21, and a significant value (*P*-value) of 0.03. Since the obtained $P < 0.05$. There is a significant difference between the two groups in stress levels.

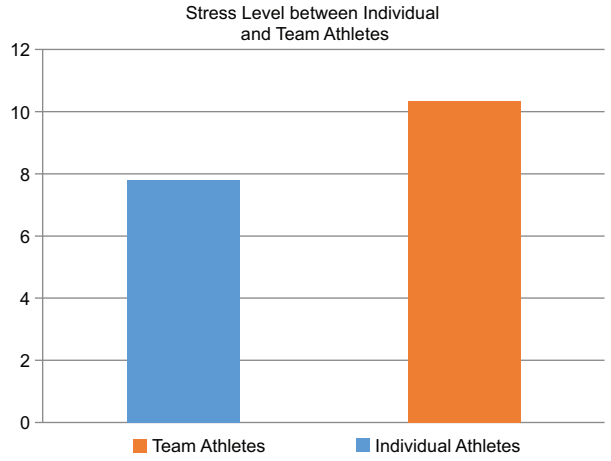
Scores of stress levels between individual and team athletes

Table 1: Independent *t*-test comparing the depression between individual and team athletes

Groups	*n*	Mean	SD	MD	*t*	*P*
Individual athletes	15	6.20	2.98	−1.0	−1.10	2.80
Team athletes	15	7.20	1.85			

SD: Standard deviation. *Significant at 0.05 level

Stress	
Individual athletes	7.8
Team athletes	10.33



DISCUSSION OF FINDINGS

Our findings indicated no significant difference in depression level between the individual and team athletes. However, the mean comparison shows that team athletes have higher depression levels than individual athletes. There was also no significant difference obtained in anxiety level between the individual and team athletes. However, the mean comparison shows that the individual athletes have higher anxiety levels than the team athletes. Moreover, there was a significant difference in stress level between the individual and team athletes. However, the mean comparison shows that team athletes have higher stress levels than individual athletes.

DISCUSSION OF HYPOTHESIS

It was hypothesized that individual and team athletes could differ significantly in terms of depression. Since the obtained statistic shows no significant difference, the hypothesis is rejected. It was also hypothesized that individual and team athletes could differ significantly in terms of anxiety. Since the obtained statistic shows no significant difference, the hypothesis is rejected. In addition, it was hypothesized

Table 2: Independent *t*-test comparing the anxiety between individual and team athletes

Groups	*n*	Mean	SD	MD	*t*	*P*
Individual athletes	15	8.26	2.89	0.93	0.92	0.36
Team athletes	15	7.33	2.60			

SD: Standard deviation. *Significant at 0.05 level

Table 3: Independent *t*-test comparing the stress between individual and team athletes

Groups	*n*	Mean	SD	MD	*t*	*P*
Individual athletes	15	7.80	3.36	-2.53	-2.21	0.03*
Team athletes	15	10.33	2.87			

SD: Standard deviation. *Significant at 0.05 level

that there might be a significant difference in stress levels between team and individual athletes. The hypothesis is accepted because the obtained statistic indicates a substantial difference.

CONCLUSION

The results of the study indicated a significant difference in the DASS-21 level of individual and team athletes.

- There were extreme severities of depression in individual and team athletes
- There were extreme severities of anxiety in individual athletes and moderate severity in team athletes
- There were moderate severities of stress in team athletes, which were normal and moderate in individual athletes.

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Research Article

Impact of interval training under different training conditions on leg strength of long-distance athletes

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ABSTRACT

The purpose of this study was to investigate the effect of interval training performed under different training conditions on leg strength among long-distance athletes. Thirty male runners aged 18–25 years were randomly assigned into three groups: Interval training group, hill training group, and control group (CG) (n = 10 each). The experimental groups followed a 12-week training program 3 times per week. Leg strength was measured using a Leg Dynamometer. The collected data were analyzed using descriptive statistics, analysis of covariance, and Bonferroni *post hoc* test. Results revealed significant improvements in leg strength among the experimental groups compared to the CG, with hill training showing the greatest improvement.

Keywords: Interval training, Leg strength, Long distance athletes etc

INTRODUCTION

Leg strength is an important physical component for long-distance runners, as it plays a crucial role in maintaining running efficiency, stride stability, and sustained performance during endurance events. In long-distance races such as the 1500 m, 3000 m, 5000 m, and 10,000 m, athletes repeatedly generate force through the lower limbs to propel the body forward. Strong leg muscles help runners maintain proper running mechanics, improve stride effectiveness, and delay the onset of muscular fatigue during prolonged running activity.

Scientific training methods are essential for improving muscular strength and endurance performance among long-distance athletes. Interval training is widely recognized as one of the most effective training methods for enhancing both physiological and muscular performance. This training method involves repeated bouts of high-intensity exercise alternated with recovery periods, which stimulate multiple energy systems and improve overall athletic performance.

Interval training can be performed under different training conditions, such as on flat surfaces or on inclined terrain. Hill-based interval training provides additional resistance due to gravitational force, which increases the workload on the leg muscles, particularly the quadriceps, hamstrings, and calf muscles. This form of training can enhance muscular strength, neuromuscular coordination, and running economy. Conventional interval training performed on flat surfaces focuses more on speed endurance and cardiovascular efficiency, while still contributing to muscular strength through repeated high-intensity running efforts.

Previous studies in endurance sports indicate that structured interval training programs can improve muscular strength, aerobic capacity, and running performance. Uphill running and resistance-oriented running drills have been shown to increase lower-limb force production and muscular endurance. These adaptations are essential for maintaining efficient movement patterns and performance in long-distance running events.

However, limited research has examined the comparative effects of interval training performed under different training conditions on leg strength among long-distance runners, particularly within regional athletic populations. Therefore, the present study aims to investigate the impact of interval training under different training conditions on leg strength among long-distance athletes, measured using the leg dynamometer test.

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Aim of the Study

The aim of the study was to examine the influence of interval training under different training conditions on leg strength among long-distance athletes.

Hypothesis

It was hypothesized that significant differences would exist in leg strength among long-distance athletes subjected to interval training, hill training, and control conditions.

METHODOLOGY

Experimental Design

The present study adopted a true random group design with pre-test and post-test measures. A total of thirty male long-distance athletes were randomly assigned into three groups of ten subjects each. The groups consisted of an interval training group (ITG), a hill training group (HTG), and a control group (CG).

The experimental groups underwent their respective training programs for a period of 12 weeks, with training sessions conducted 3 days per week. The CG did not participate in any specific training program but continued their regular daily activities.

Leg strength was assessed for all subjects before the commencement of the training program (pre-test) and after the completion of the 12-week training program (post-test) using a leg dynamometer. The collected data were statistically analyzed to determine the effectiveness of the training interventions.

Selection of Subjects

The subjects for the present study were thirty male long-distance runners aged between 18 and 25 *year*s, selected from various degree colleges, sports academies, and university training centers in Hyderabad district, Telangana State.

All the participants had at least 2 *year*s of experience in long-distance running events and were actively participating in athletic competitions. The subjects volunteered to participate in the study after being informed about the purpose and procedures of the experiment.

Sample of the Study

T*abl*e 1 presents the distribution of subjects selected for the study.

Selection of Variables

For the present study, leg strength was selected as the variable to examine the effect of interval training under different training conditions on long-distance athletes. Leg strength is an essential component for maintaining running efficiency, stability, and propulsion during endurance events. In this study, leg strength was measured using the Leg Dynamometer Test, which is a reliable method for assessing the maximum isometric strength of the leg muscles. During the test, the subject exerts maximum force against the dynamometer, and the highest force recorded in kilograms is taken as the score for leg strength. This test provides an objective measurement of lower limb muscular strength.

Table 1: The sample of the study

S. No.	Groups and training type		No of subjects
1.	Experimental group 1	Interval training group	10
2.	Experimental group 2	Hill training group	10
3.	Control group	Control group	10
	Total		30

Training Programme

The training program was conducted for a period of 12 *week*s, with three training sessions per week.

ITG performed repeated bouts of high-intensity running on a flat surface with specified recovery intervals.

HTG performed repeated uphill running exercises designed to increase resistance and muscular demand on the lower limbs. CG did not participate in any specialized training program during the experimental period.

Statistical Techniques

The data collected from the pre-test and post-test were statistically analyzed using appropriate statistical methods. Mean and Standard Deviation were calculated to describe the central tendency and variability of the scores. To determine the significant differences among the groups, Analysis of Covariance (ANCOVA) was applied. Further, when significant differences were found, the Bonferroni *post hoc* Test was used to identify the specific group differences. The level of significance was fixed at 0.05 for all statistical analyses.

RESULTS

Group	Pre-test mean	Post-test mean	Adjusted mean
Control	120.4	121.6	121.2
Hill training	119.8	135.7	134.9
Interval training	120.1	130.5	129.8

ANCOVA table					
Source	**SS**	**df**	**MS**	**F**	***P***
Between groups	624.52	2	312.26	8.74	<.01
Within groups	964.80	27	35.73		
Total	1589.32	29			

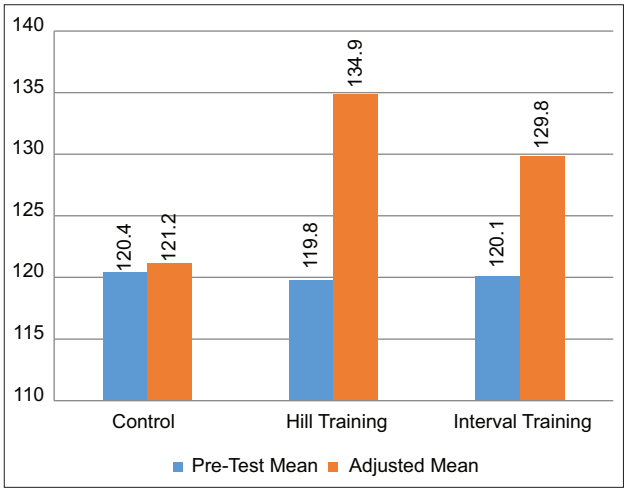

Figure 1: Comparison of pre- and adjusted post-test mean scores for leg strength among control and experimental groups

DISCUSSION

The results of the study showed significant improvements in leg strength among the experimental groups compared to the CG. The pre-test mean values of the CG (120.4), HTG (119.8), and ITG (120.1) indicate that all three groups were almost equal before the training program.

After 12 weeks of training, the post-test mean values showed greater improvement in the experimental groups. The HTG recorded the highest improvement (135.7), followed by the ITG (130.5), while the CG showed only a slight change (121.6). The adjusted post-test means also indicated that both training groups performed better than the CG.

The ANCOVA results ($F = 8.74$, $P < 0.01$) revealed significant differences among the groups, indicating that the training programs had a significant effect on leg strength. The greater improvement in the HTG may be due to the additional resistance provided by uphill running, which increases muscular effort in the lower limbs. Therefore, the findings suggest that hill training and interval training are effective methods for improving leg strength among long-distance athletes.

CONCLUSION

Based on the results of the present study, it can be concluded that interval training performed under different training conditions significantly improves leg strength among long-distance athletes. Both the HTG and ITG showed greater improvement in leg strength compared to the CG. Among the training methods, hill training produced the highest improvement, indicating that running against resistance is more effective for developing lower limb muscular strength. Therefore, incorporating hill-based interval training and structured interval training programs can be beneficial for enhancing leg strength and overall performance in long-distance athletes.

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Research Article

Effect of circuit training program on flexibility among female Kabaddi players of Vizianagaram district

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ABSTRACT

Objective: The objective of the study was to examine the impact of a 12-week circuit training program on flexibility, as measured by the sit-and-reach test, among female Kabaddi players of Vizianagaram district. **Methods:** Three hundred (n = 300) female Kabaddi players (18–22 years) were randomly assigned to an experimental group (n = 150, circuit training) and a control group (n = 150, no training). Flexibility was measured using the sit-and-reach test (distance in centimeters). Both groups underwent pre- and post-testing. Data were analyzed using paired t-tests within groups and an independent-samples t-test on gain scores (α = 0.05). **Results:** The experimental group showed a statistically significant improvement in flexibility, increasing from 26.20 cm to 29.14 cm ($P < 0.05$), whereas the control group showed no significant change (25.80 cm to 25.79 cm; $P = 0.969$). Between-group comparison confirmed a significant effect of the circuit training program on flexibility ($P < 0.05$). **Conclusion:** A 12-week circuit training program resulted in a significant improvement in flexibility among female Kabaddi players from Vizianagaram district.

Keywords: Circuit training, Female Kabaddi players, Flexibility, Sit and reach

INTRODUCTION

Kabaddi is a traditional combative team sport that originated in India and has gained international recognition in recent decades. It is characterized by intense physical contact, quick reflexes, and coordinated team strategy. The sport requires a combination of power, speed, agility, endurance, and mental alertness to outmaneuver opponents effectively. Played between two teams on a marked court, the primary objective is for a raider to enter the rival half, score by tagging defenders, and return safely without being tackled. Throughout the raid, the player must sustain a continuous chant of "Kabaddi," reflecting breath control, concentration, and technical proficiency during play.

Circuit training is a systematic method of physical conditioning that involves performing a series of exercises in a prescribed sequence, referred to as a "circuit," with limited rest intervals between stations. It integrates strength exercises, mobility drills, and dynamic movements within a single training session, thereby improving overall physical efficiency. When designed appropriately, circuit training can significantly enhance flexibility by incorporating stretching exercises, dynamic range-of-motion activities, and functional movements that promote joint mobility. Such training contributes to improved muscle elasticity, better posture, and greater movement efficiency, which are essential for optimal sports performance.

Flexibility plays a key role in Kabaddi, as the sport demands rapid directional changes, swift dodging movements, and dynamic body control during both raiding and defending. Players frequently perform lunges, kicks, bends, and twisting actions that require a wide range of motion at the hip, knee, shoulder, and trunk joints. Adequate flexibility enhances performance efficiency, allows raiders to evade tackles effectively, and enables defenders to execute holds and blocks with better reach and control. Moreover, improved flexibility contributes to injury prevention by reducing muscle stiffness and enhancing joint mobility, which is essential in a high-intensity contact game like Kabaddi.

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Need and Scope of the Study

Kabaddi holds a prominent place in the sporting culture of Vizianagaram district, demanding a unique blend of physical efficiency, tactical awareness, and technical skill, particularly among female players who are increasingly participating in competitive formats. Among the various physical components required for success in Kabaddi, flexibility plays a crucial role in executing swift raids, evasive movements, kicks, and defensive holds. As the standards of competition continue to rise, coaches and athletes are exploring systematic and scientifically supported training methods to enhance specific fitness components essential for improved performance.

Although conventional training practices remain valuable, there is a growing necessity to incorporate structured and research-based approaches that specifically address flexibility development. Despite the recognized importance of flexibility in Kabaddi, limited empirical research has examined the effectiveness of circuit training programs in improving flexibility among female Kabaddi players in Vizianagaram district. This gap in the literature underscores the need for focused investigation in this area.

Therefore, the present study seeks to evaluate the effect of a structured circuit training program on flexibility among female Kabaddi players of Vizianagaram district. The outcomes of this research may assist coaches and trainers in designing scientifically informed training strategies that effectively enhance flexibility and overall performance in Kabaddi.

Significance of the Study

The study examines the impact of a circuit training program on flexibility among Kabaddi players of Vizianagaram district with respect to the selected motor fitness component.

Aim of the Study

The aim of the study was to examine the effect of a 12-week circuit training program on flexibility (sit-and-reach test) among female Kabaddi players (18–22 years) in Vizianagaram district.

Hypothesis

It was hypothesized that there would be a significant difference in the effect of the circuit training program among Kabaddi players on the selected motor ability in relation to flexibility.

METHODOLOGY

Design

The study design was a pre–post experimental group design.

Participants

Three hundred ($n = 300$) female Kabaddi players (18–22 years) from Vizianagaram district were selected through simple random sampling. The selected participants were equally divided into two groups: Experimental Group ($n = 150$), which underwent circuit training, and the control group ($n = 150$), which did not participate in the specialized training program.

Training Program

The experimental group participated in a 12-week circuit training program (3 sessions/week) comprising 8–10 stations designed to improve flexibility. The program included dynamic stretching exercises, static stretching drills, mobility exercises, core stability movements, and functional range-of-motion activities. The control group continued their regular activities without additional training intervention.

Testing

Flexibility was assessed using the sit-and-reach test before and after the 12-week training period.

Statistical Analysis

Data were analyzed using the paired-samples *t*-test to compare the means [Table 1].

Selection of Variables

The researcher reviewed the relevant scientific literature related to the present investigation based on expert consultation, feasibility considerations, availability of necessary equipment, and the suitability of the selected variable to the objectives of the study. Accordingly, the selected motor fitness variable for this study was flexibility, which was assessed using the sit-and-reach test.

Experimental Design

1. A total of 300 female Kabaddi players belonging to the age group of 18–22 years from Vizianagaram district of Andhra Pradesh state were selected as subjects for the study
2. The selected subjects were randomly divided into two equal groups consisting of 150 participants each
3. One group comprised 150 subjects as the experimental group, and the other 150 subjects as the control group. The control group did not participate in any specialized training program. Pre-test data on flexibility were collected before the commencement of the training program, and post-test data were recorded for both groups after the completion of the training period
4. The experimental group underwent 12 weeks of circuit training designed to improve flexibility, while the control group continued with their regular routine activities.

Table 1: The sample of the study

S. No	Vijayanagaram district (Andhra Pradesh) Female Kabaddi players		No of female Kabaddi players
1.	Experimental group	Circuit training	150
2.	Control group	No training	150
	Total		300

Collection of Data

To collect the data, the sit-and-reach test was administered to both the experimental and control groups, and the scores were recorded systematically in the observation sheets for each group.

Testing Tool

Flexibility – sit-and-reach test.

Statistical Technique

The data collected from both groups on the selected variable were analyzed statistically to determine whether significant differences existed between the pre-test and post-test scores of the experimental and control groups. The paired-samples *t*-test was employed to compare the mean scores and calculate the *t*-ratio for changes in flexibility among female Kabaddi players. The level of significance was set at the 0.05 level of confidence.

RESULTS OF FLEXIBILITY

Table presents the pre-test and post-test mean scores of flexibility for the female control (FC) and female experimental (FE) groups of Kabaddi players from Vizianagaram district, Andhra Pradesh, aged 18–22 years. Flexibility was assessed using a standardized flexibility test. A paired-samples *t* test was applied to determine whether a significant difference existed between the pre-test and post-test scores following the experimental training program. The level of significance was fixed at $\alpha = 0.05$.

For the FC group ($n = 150$), the pre-test mean flexibility score was M = 25.796 with a standard deviation of SD = 1.9696, while the post-test mean score was M = 25.7947 with SD = 2.0451. The obtained *t* value was $t\ (149) = 0.04$, which did not exceed the critical table value of 1.976 required for significance at the 0.05 level. The result was found to be statistically not significant ($P = 0.969$). Hence, no significant difference was observed between the pre-test and post-test flexibility performances of the FC group.

In contrast, the FE group ($n = 150$) demonstrated a significant improvement in flexibility performance following the experimental training program. The pre-test mean flexibility score was M = 26.2033 with a standard deviation of SD = 4.7271, whereas the post-test mean score increased to M = 29.136 with SD = 4.9163. The calculated *t* value of t (149) = −34.59 was far greater than the critical value of 1.976 at the 0.05 level of confidence. Therefore, the difference between the pre-test and post-test mean flexibility scores of the FE group was found to be statistically highly significant ($P < 0.05$).

DISCUSSION

The findings of the present investigation indicate that the experimental training program did not produce a statistically significant improvement in flexibility performance among participants in the FC group. The negligible difference between pre-test and post-test mean scores suggests that flexibility levels remained relatively unchanged in the absence of a structured and specialized training intervention.

On the other hand, the FE group exhibited a statistically significant and meaningful improvement in flexibility following the intervention. The notable increase in post-test mean flexibility scores reflects enhanced joint mobility, muscle elasticity, and range of motion among the experimental group participants. These improvements are particularly important in Kabaddi, where greater flexibility contributes to efficient body movements, injury prevention, and improved execution of offensive and defensive skills.

The significant improvement observed in the FE group can be attributed to the systematic and progressive nature of the experimental training program, which likely included stretching exercises, mobility drills, and sport-specific flexibility components. The absence of a comparable improvement in the control group further confirms that the observed enhancement in flexibility performance was a direct result of the experimental intervention rather than normal variation or routine physical activity.

Overall, the findings clearly demonstrate that the experimental training program was effective in significantly enhancing flexibility performance among female Kabaddi players.

Figure 1 illustrates the comparison of pre-test and post-test mean flexibility scores of the FC and FE groups. The graphical representation shows negligible variation in flexibility performance for the FC group, whereas a substantial improvement is clearly evident in the FE group. This visual trend strongly supports the statistical findings and confirms the effectiveness of the experimental training program in improving flexibility performance among female Kabaddi players.

Parameter	Group	*n*	Pre mean	Pre SD	Post mean	Post SD	*t*-ratio	Significant
Flexibility	FC	150	25.796	1.9696	25.7947	2.0451	0.04	0.969
Flexibility	FE	150	26.2033	4.7271	29.136	4.9163	−34.59	0

FC: Female control, FE: Female experimental, SD: Standard deviation

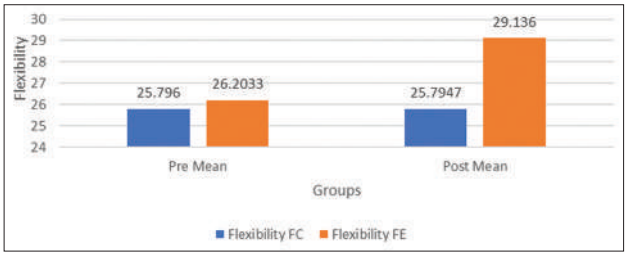

Figure 1: Comparison of pre-test and post-test mean flexibility scores of female control and female experimental groups

CONCLUSION

The results of the study indicate that the experimental group circuit training program significantly improved flexibility among female Kabaddi players. While the control group showed no significant change between pre-test and post-test scores, the experimental group demonstrated a statistically significant improvement at the 0.05 level of significance. The findings confirm that structured and systematic flexibility training effectively enhances the range of motion and overall performance. Therefore, the experimental program can be recommended for improving flexibility in female Kabaddi players.

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Research Article

Impact of plyometric and strength training programs on agility among volleyball players of Hyderabad district

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ABSTRACT

The professionalization of volleyball has increased the importance of a scientifically designed conditioning program. The present study examined the comparative effects of a 12-week plyometric training program and a 12-week strength training program on agility among volleyball players of Hyderabad District (Telangana). Three hundred male volleyball players (n = 300), aged 18–22 years, were selected using simple random sampling and divided into three equal groups: Plyometric training (n = 100), strength training (n = 100), and control (n = 100). Agility was assessed using the 4 × 10 m shuttle run test. Pre-test scores were recorded before the intervention, and post-test scores were obtained after 12 weeks of training (3 days/week). Analysis of covariance was applied to adjust for baseline differences, followed by Bonferroni *post hoc* comparisons. The obtained F ratio (173.464) exceeded the critical value at the 0.05 level, indicating significant differences among groups. Both experimental groups showed significant improvement compared to the control group, whereas no significant difference was observed between the plyometric and strength training groups. The findings suggest that both training methods are equally effective in enhancing agility performance among volleyball players.

Keywords: Agility, Motor fitness, Plyometric training, Strength training, Volleyball

INTRODUCTION

Overview of the Study

Contemporary sport performance increasingly relies on scientific conditioning systems and structured training methodologies. Volleyball, characterized by explosive rallies and rapid positional transitions, requires a combination of technical proficiency, tactical awareness, and well-developed motor fitness components.

In India, volleyball is widely played across educational institutions and competitive platforms. The city of Hyderabad has emerged as a prominent center for volleyball talent, with structured district competitions and university-level tournaments conducted under the Association of Indian Universities and state events organized by the Telangana Volleyball Association.

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With increasing competition intensity, marginal improvements in physical fitness parameters such as agility can significantly influence match outcomes. Consequently, strength and plyometric training methods have been integrated into volleyball conditioning programs to enhance motor performance.

Background of the Study

Historically, volleyball training in India emphasized general conditioning and skill repetition. However, advancements in sports science have introduced periodized resistance training, neuromuscular conditioning, and structured plyometric systems. These methods target physiological adaptations such as improved motor unit recruitment, rate of force development, and enhanced stretch–shortening cycle efficiency.

Agility is particularly critical in volleyball due to constant changes in movement direction, defensive transitions, and recovery actions. It contributes substantially to defensive performance and successful court coverage. Therefore, evaluating the effectiveness of structured training methods on agility is both scientifically relevant and practically valuable.

Review of Related Literature

Previous research supports the role of resistance and plyometric training in improving agility and neuromuscular coordination. According to Kraemer and Ratamess (2004), progressive resistance training enhances muscular strength and movement efficiency. Similarly, Verkhoshansky and Siff (2009) emphasized that plyometric exercises improve stretch–shortening cycle performance, contributing to faster directional changes.

However, limited research has compared the relative effects of these two training modalities among volleyball players in Hyderabad District, thereby justifying the present investigation.

Purpose of the Study

To examine and compare the effects of plyometric training and strength training programs on agility among volleyball players of Hyderabad District.

Hypotheses

- H_0: There will be no significant difference between strength training and plyometric training groups in agility.
- H_1: There will be a significant difference between strength training and plyometric training groups in agility.

METHODOLOGY

Research Design

The present investigation employed a randomized pre-test–post-test experimental design comprising two experimental groups and one control group. This design was selected to examine the comparative effects of plyometric and strength training on agility performance while controlling for baseline differences among participants.

A total of 300 (n = 300) male volleyball players between the ages of 18 and 22 years were selected from Hyderabad District, Telangana. Participants were selected using a simple random sampling method to ensure equal representation and minimize selection bias. Following selection, the subjects were randomly allocated into three equal groups:

- Plyometric training group (n = 100)
- Strength training group (n = 100)
- Control group (n = 100).

Selection of Variable

The primary dependent variable of the study was agility. Agility performance was assessed using the 4 × 10-m shuttle run test, a standardized field test commonly used to evaluate speed and change-of-direction ability.

Training Protocol

The duration of the experimental intervention was 12 weeks, with training sessions conducted 3 days/week on non-consecutive days to allow adequate recovery.

The plyometric training group participated in a systematically structured program consisting of progressive jump exercises and volleyball-specific explosive drills. The exercises were designed to enhance neuromuscular coordination, reactive strength, and quick directional changes.

The strength training group followed a progressive resistance training program targeting major muscle groups relevant to volleyball performance. Training intensity ranged between 60% and 85% of the one-repetition maximum, ensuring gradual overload and adaptation across the training period.

The control group did not participate in any specialized training program during the intervention period. Participants in this group continued their routine physical activities and regular volleyball practice without additional structured exercises.

Statistical Analysis

Descriptive statistics, including mean and standard deviation, were calculated to summarize the data. To determine the effectiveness of the interventions while adjusting for pre-test differences, Analysis of covariance (ANCOVA) was applied. When significant differences were identified, the Bonferroni *post hoc* test was conducted to determine specific group-wise differences.

The level of statistical significance was set at $P \leq 0.05$. All statistical analyses were performed using the Statistical Package for the Social Sciences.

RESULTS

ANCOVA on Agility

The obtained F ratio was tested at the 0.05 level of confidence. The table value required at df (2.296) is 3.03. Since the calculated F value is greater than the table value, the result is statistically significant.

Table 1 presents the ANCOVA results on the agility performance of the control group, plyometric training group, and strength training group.

The pre-test mean and standard deviation values of agility were 11.2048 ± 0.21338 for the control group, 11.2833 ± 0.30068 for the plyometric training group, and 11.2332 ± 0.19117 for the strength training group. The pre-test scores indicated that the three groups were comparable at the baseline level with respect to agility performance.

After the training period, in order to eliminate the influence of initial differences, ANCOVA was employed by taking the pre-test scores as a covariate. The adjusted post-test mean values were 11.1751 for the control group, 10.9949 for the

Table 1

Test	Control group	Plyometric training group	Strength training group	SS	DF	MS	F ratio
Pre-test mean	11.2048	11.2833	11.2332	Between	3.277	2	173.464
SD	0.21338	0.30068	0.19117	Within	2.796	296	
Adjusted post-test mean	11.1751	10.9949	10.9233	Between	3.277	2	173.464
				Within	2.796	296	

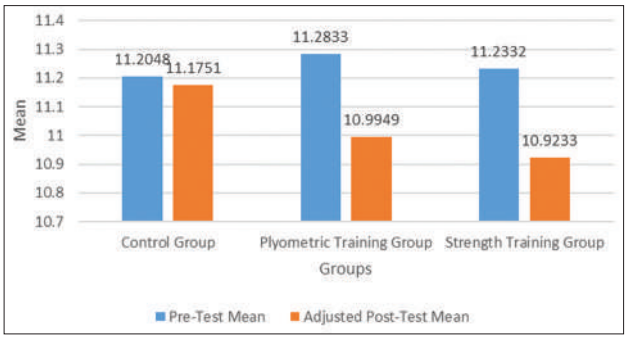

Figure 1: Comparison of pre- and adjusted post-test mean scores for agility among control and experimental groups

plyometric training group, and 10.9233 for the strength training group.

The obtained F ratio was 173.464. The F value was tested at the 0.05 level of confidence, for which the table value required at df (2.296) is 3.03. Since the calculated F value (173.464) is greater than the table value (3.03), the difference among the adjusted post-test means of the three groups is statistically significant.

Hence, it is concluded that the training programs have a significant effect on agility performance.

To determine which of the paired means differed significantly, the Bonferroni *post hoc* test was applied, and the results are presented below.

Results of *Post Hoc* Test on Agility

Bonferroni post hoc comparisons (agility-adjusted means)

Group 1	Group 2	Mean difference	Sig. (*P*-value)
Control	Plyometric	0.180	0.000*
Control	Strength	0.251	0.000*
Plyometric	Strength	0.071	1.000 (NS)

*Significant at $P \leq 0.05$ level. NS: Not significant

Significant comparisons

- Control versus plyometric
- Control versus strength.

The mean differences (0.180 and 0.251) were significant at the 0.05 level, indicating that both plyometric training and strength training produced significantly better agility performance than the control group.

Insignificant comparison

- Plyometric versus strength (Mean difference = 0.071, $P = 1.000$)

This indicates that there was no significant difference between plyometric training and strength training in improving agility performance. Both training methods were equally effective in enhancing agility.

DISCUSSION

The findings indicate that both plyometric and strength training programs significantly improved agility compared to the control group. Plyometric training enhances neuromuscular coordination and stretch–shortening cycle efficiency, while strength training improves force production and stabilization.

However, the absence of a significant difference between the two experimental groups suggests that both plyometric and strength training programs are equally effective in improving agility performance among volleyball players.

CONCLUSION

Within the limitations of the study, it was concluded that:

- Plyometric and strength training programs significantly improve agility among volleyball players
- Both plyometric and strength training programs are equally effective
- Structured 12-week training interventions that are conducted 3 times/week are recommended for improving agility in competitive volleyball players.

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Research Article

Comparative effects of 6-week French contrast training and triphasic training on speed, agility, and vertical jump in male amateur athletes

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ABSTRACT

Purpose: This study aimed to compare the effects of a 6-week French contrast training (FCT) program versus a triphasic training (TPT) program on speed, agility, and vertical jump performance in male amateur athletes. **Methods:** Thirty collegiate athletes (age 18–25) were randomly assigned to one of three groups: FCT (n = 10), TPT (n = 10), or a Control group (CON, n = 10). The experimental groups underwent supervised training 3 times/week for 6 weeks, whereas the CON group maintained their regular sport-specific training. Speed (40 m sprint), agility (modified agility t-test), and vertical jump (countermovement jump) were assessed pre- and post-intervention. Data were analyzed using analysis of covariance with pre-test scores as covariates. **Results:** Both FCT and TPT groups demonstrated significant improvements compared to the CON group in agility (FCT: P = 0.002; TPT: P = 0.008) and vertical jump (both P < 0.001). For the 40 m sprint, only the FCT group showed a statistically significant improvement over the CON group (P = 0.014). There were no significant differences between the FCT and TPT groups for any of the performance variables. **Conclusion:** The findings indicate that both FCT and TPT are effective modalities for enhancing key athletic performance metrics in amateur athletes over 6 weeks. FCT may be marginally more effective for improving linear speed, while both methods yield comparable gains in agility and lower-body power. Strength and conditioning professionals can utilize either method based on the athlete's needs and program context.

Keywords: Athletic performance, Complex training, Post-activation performance enhancement, Power development, Strength and conditioning

INTRODUCTION

The pursuit of optimal training methods to enhance athletic performance is a central focus of sports science. For amateur athletes, who often balance academic and athletic commitments, efficient and evidence-based training strategies are paramount (Smith, 2014). Modern training has evolved to include neuromuscular-based approaches designed to improve explosive power and functional strength, which are critical for sports requiring rapid changes of direction, acceleration, and high-velocity movements (Kraemer, 2004; Turner, 2018).

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Among advanced training models, French contrast training (FCT) has gained popularity for its integration of maximal strength and plyometric exercises within a single session. Developed from complex and contrast training principles, FCT utilizes a sequence of a heavy compound lift followed by plyometric and speed-strength movements to exploit post-activation potentiation (PAP), thereby enhancing rate of force development and power output (Verkhoshansky, 2009; Hernández-Preciado, 2018).

Conversely, triphasic training (TPT) approaches athlete development by systematically targeting the three phases of muscle contraction: eccentric, isometric, and concentric. This method is predicated on the understanding that athletic movements are not merely singular actions but a rapid interplay of these phases. For instance, a countermovement jump (CMJ) utilizes an eccentric loading phase to store elastic energy, a

brief isometric transition, and a powerful concentric drive. TPT structures training blocks typically last several weeks each to deliberately overload one specific phase at a time. The initial eccentric phase block focuses on developing the ability to decelerate forces and load muscles under tension. The subsequent isometric block enhances the capacity to stabilize and transmit force through the body's kinetic chain. Finally, the concentric block emphasizes explosive force production. By isolating and overloading each phase, TPT aims to optimize neuromuscular control and force production capacity throughout the entire movement cycle, building a more robust foundation for power expression (Dietz, 2012; Suchomel, 2016).

While both methodologies have demonstrated efficacy in improving athletic performance, direct comparative studies, particularly in amateur athletic populations, are limited (Natera, 2020). Therefore, this study sought to compare the effects of a 6-week FCT program with a TPT program on speed, agility, and vertical jump performance in male amateur college athletes.

METHODS

Participants

Thirty male collegiate athletes (age 18–25 years) from the Sports Authority of India – Lakshmibai National College of Physical Education, Thiruvananthapuram, were recruited. Participants had a minimum of 1 year of resistance training experience and were free from musculoskeletal injury. Using G*Power software, a sample size of 30 was determined to provide adequate statistical power (0.95) for detecting meaningful effects (effect size f = 0.75, $\alpha = 0.05$). Participants were randomly assigned to FCT, TPT, or Control (CON) groups ($n = 10$ each).

Experimental Design

A randomized controlled trial design was employed. Pre-test assessments were conducted 1 week before the intervention, and post-test assessments were administered immediately after the 6-week training period. The CON group maintained their regular sport-specific training without additional interventions.

Training Interventions

- FCT: The FCT protocol involved complex training sessions twice weekly, structured in four-exercise clusters (e.g., back squat → hurdle jumps → weighted jumps → sprint). Rest periods were 30 s between exercises and 3 min between clusters
- TPT: The TPT group followed a periodized program 3 times/week, emphasizing a different muscle action every 2 weeks: Eccentric (weeks 1–2), isometric (weeks 3–4), and concentric (weeks 5–6)
- CON group: Maintained standard sport-specific practice without any additional strength-power training.

Testing Procedures

- Speed: Assessed through a 40-m linear sprint test, timed using the MySprint iOS application (test-retest r = 0.885)
- Agility: Assessed using the modified agility *t*-test, timed with the COD timer app (test-retest r = 0.962)
- Vertical jump: Assessed through CMJ height using the My Jump 2 application (test-retest r = 0.912).

Training Programme

TPT plan

FCT plan

Statistical Analysis

Data were analyzed using IBM Statistical Package for the Social Sciences (v.28.0). Descriptive statistics (mean ± standard deviation) were calculated. Assumptions of normality (Shapiro–Wilk) and homogeneity of variance (Levene's test) were checked. A one-way analysis of covariance (ANCOVA), with pre-test scores as a covariate, was used to compare post-test performance between groups. For vertical jump, where homogeneity of variance was violated ($P = 0.041$), Welch's ANOVA was employed. *Post hoc* analyses used least significant difference tests. Statistical significance was set at $P < 0.05$.

RESULTS

Speed (40 m Sprint)

After controlling for baseline performance, the ANCOVA revealed a significant main effect of training group ($F[2,26] = 3.484$, $P = .046$, $\eta^2 = 0.211$). *Post hoc* analysis showed that the FCT group significantly outperformed the CON group (mean difference = −0.063s, $P = 0.014$). The TPT group also improved, but the difference from the CON was not statistically significant (mean difference = −0.031s, $P = 0.215$). There was no significant difference between the FCT and TPT groups ($P = 0.198$). Adjusted post-intervention means were: FCT: 6.077s, TPT: 6.109s, CON: 6.140s.

Agility (Modified *t*-Test)

A significant main effect of training group was found after adjusting for pre-test scores ($F[2,26] = 6.152$, $P = .006$, $\eta^2 = 0.321$). Both the FCT (mean difference = −0.563s, $P = 0.002$) and TPT (mean difference = −0.469s, $P = 0.008$) groups demonstrated significantly better performance than the CON group. No significant difference was found between the two experimental groups ($P = 0.572$). Adjusted post-intervention means were: FCT: 6.126s, TPT: 6.333s, CON: 6.462s.

Vertical Jump (CMJ Height)

The analysis showed a significant and large main effect of training group ($F[2,26] = 21.327$, $P < 0.001$, $\eta^2 = 0.621$). Both the FCT (mean difference = +2.02 cm, $P < 0.001$) and TPT (mean difference = +2.25 cm, $P < 0.001$) groups jumped

exercise	Eccentric						isometric						concentric					
	Week 1			Week 2			Week 3			Week 4			Week 5			Week 6		
	INT	SxR	TMP	INT	SxR	TMP	INT	SxR	TMP	INT	SxR	TMP	INT	SxR	TMP	INT	SxR	TMP
	DAY 1																	
BENCH PRESS	60%	3X8	5:0:X:0	70%	3X6	5:0:X:0	80%	3X4	0:3:X:0	65%	3X6	0:3:X:0	85%	3X4	0:0:X:0	90%	3X3	0:0:X:0
LYING MEDBALL CHEST PASS	4 KG	3X12	FAST	5KG	4X12	FAST	6KG	3X10	FAST	5KG	4X8	FAST	8 kg	3x8	fast	10kg	4x8	fast
PULL UP	BW	3X5	4:0:X:0	BW	3X5	4:0:X:0	BW	3X6	0:0:X:3	BW	3X5	0:0:X:3	BW	3X8	0:0:X:0	BW	3X8	0:0:X:0
DB BSS	20%	3X8	3:0:X:0	30%	3X8	3:0:X:0	40%	3X6	0:3:X:0	30%	3X8	0:3:X:0	45%	3X6	0:0:X:0	55%	3X6	0:0:X:0
DB LATARAL RAISE	10%	3X12	3:0:0:0	15%	3X12	3:0:0:0	20%	3X10	0:0:0:2	15%	3X8	0:0:0:2	25%	3X8	0:0:0:0	30%	3X8	0:0:0:0
COPENHAGEN PLANK	20sec each leg	3 set	3:0:0:0	30sec each leg	3 set	3:0:0:0	40sec each leg	3 set	0:0:0:2	30sec each leg	3 set	0:0:0:2	45sec each leg	3 set	0:0:0:0	1min each leg	3 set	0:0:0:0
CALF RAISE	25%	3X12	3:0:X:0	30%	3X12	3:0:X:0	40%	3X10	0:0:X:2	35%	3X8	0:0:X:2	45%	3X10	0:0:X:0	50%	3X10	0:0:X:0
	DAY 2																	
BACK SQUAT	60%	3X8	5:0:X:0	70%	4X6	5:0:X:0	80%	3X4	0:3:X:0	65%	4x6	0:3:X:0	85%	3X3	0:0:X:0	90%	3X3	0:0:X:0
TUCK JUMP	BW	3X10	FAST	BW	3X10	FAST	BW	3X8	FAST	BW	3x10	FAST	BW	3X6	FAST	BW	4X6	FAST
DUMBELL SQUAT JUMP	20%	3X10	3:0:X:0	30%	3X10	3:0:X:0	40%	3X6	0:3:X:0	30%	3x8	0:3:X:0	50%	3X6	0:0:X:0	60%	3X6	0:0:X:0
BAND ASSI JUMP	BW	3X10	FAST	BW	3X10	FAST	BW	3X6	FAST	BW	3x8	FAST	BW	3X6	FAST	BW	3X4	FAST
DB INCL BENCH PRESS	50%	3X10	3:0:X:0	60%	3X8	3:0:X:0	70%	3X6	0:3:X:0	55%	3x10	0:3:X:0	75%	3X6	0:0:X:0	80%	3X4	0:0:X:0
FEET ELEVATED INVERTED ROW	BW	3X10	3:0:X:0	BW	3X10	3:0:X:0	BW	3X8	0:0:X:3	BW	3x6	0:0X:3	BW	3X10	0:0:X:0	BW	3X10	0:0:X:0
BB HIP THRUST	60%	3X12	3:0:X:0	70%	3X10	3:0:X:0	80%	3X8	0:0:X:3	65%	3x8	0:0X:3	75%	3X10	0:0:X:0	85%	3X8	0:0:X:0
SIDE PLANK WITH HIP FLEXION	BW	3X8	3:0:X:0	BW	3X10	3:0:X:0	BW	3X12	0:2:X:0	BW	3x8	0:2:X:0	BW	3X10	0:0:X:0	BW	3X12	0:0:X:0
	DAY 3																	
MILITARY PRESS	25%	3X12	4:0:X:0	30%	3X10	4:0:X:0	40%	3X8	4:0:X:0	35%	3X8	4:0:X:0	45%	3X8	0:0:X:0	55%	3X6	0:0:X:0
LYING MED BALL BACKWARDS THROW	4KG	3X10	FAST	5KG	3X10	FAST	6KG	3X8	FAST	4KG	3X8	FAST	6KG	3X8	FAST	8KG	3X8	FAST
CHIN-UP	BW	3 x 6	4:0:X:0	BW	3X6	4:0:X:0	BW	3X7	4:0:X:0	BW	3X8	4:0:X:0	BW	3X7	0:0:X:0	BW	3X8	0:0:X:0
DB RDL	20%	3X12	3:0:X:0	25%	3X10	3:0:X:0	35%	3X10	3:0:X:0	30%	3X8	3:0:X:0	45%	3X10	0:0:X:0	55%	3X8	0:0:X:0
LANDMINE ONE ARM BARBELL SPLIT PRESS	15%	3X10	2:0:X:0	20%	3X8	2:0:X:0	25%	3X6	2:0:X:0	20%	3X8	2:0:X:0	30%	3X6	0:0:X:0	35%	3X6	0:0:X:0
BB BENT OVER ROW	30%	3X8	3:0:X:0	35%	3X8	3:0:X:0	40%	3X6	3:0:X:0	30%	3X8	3:0:X:0	50%	3X6	0:0:X:0	60%	3 X 4-6	0:0:X:0
NORDIC CURL	BW	3X8	3:0:X:0	BW	3X8	3:0:X:0	BW	3X10	3:0:X:0	BW	3X8	3:0:X:0	BW	3X10	1:0:X:0	BW	3X12	1:0:X:0
CALF RAISE	25%	3X12	3:0:X:0	30%	3X10	3:0:X:0	40%	3X10	3:0:X:0	35%	3X8	3:0:X:0	45%	3X8	0:0:X:0	50%	3X8	0:0:X:0

significantly higher than the CON group. There was no statistically significant difference between the FCT and TPT protocols (mean difference = −0.23 cm, $P = 0.560$). Adjusted post-intervention means were: FCT: 39.53 cm, TPT: 39.76 cm, CON: 37.51 cm.

DISCUSSION

The primary finding of this study is that both 6-week FCT and TPT interventions were effective in enhancing agility and vertical jump performance compared to a CON condition, with no statistically significant superiority of one method over the other.

The significant improvement in 40 m sprint performance for the FCT group can be attributed to its design, which leverages PAP. The sequential combination of heavy loading and explosive movements enhances neuromuscular coordination and the rate of force development, directly benefiting acceleration (Haffman, 2012). The TPT program, while also focusing on force production, may not have provided the same acute neural potentiation required for maximal sprint performance in this short-term intervention.

For agility and vertical jump, both training modalities were equally effective, albeit likely through different physiological mechanisms. FCT's plyometric components improve reactive strength and stretch-shortening cycle efficiency, reducing ground contact time during directional changes (Dawes, 2019). TPT, by systematically strengthening each phase of movement, optimizes force transfer from eccentric braking to

DAY	EXERCISE	WEEK 1			WEEK 2			WEEK 3			WEEK 4			WEEK 5			WEEK 6		
		Set/ rep	Int (% of 1RM & RPE)	REST	Set/ rep	Int (% of 1RM /RPE)	REST	Set/ rep	Int (% of 1RM & RPE)	REST	Set/ rep	Int (% of 1RM & RPE)	REST	Set/ rep	Int (% of 1RM & RPE)	REST	Set/ rep	Int (% of 1RM & RPE)	REST
DAY 1	Back Squat	3 X 8	60% or 5-6 rpe	3-5 min	3 X 6	70% or 6-7 rpe	3-5 min	3 X 4	80% or 6-7 rpe	3-5 min	3 X 6	65% or 5-6 rpe	3-5 min	3 X 4	85% or 7-8 rpe	3-5 min	3 X 3	90% or 8-9 rpe	3-5 min
	CMJ	3 X 8	BW	3-5 min	3 X 8	BW	3-5 min	3 X 8	BW	3-5 min	3 X 8	BW	3-5 min	3 X 8	BW	3-5 min	3 X 8	BW	3-5 min
	Loaded Trap Bar Jump	3 X 8	30% or 5-6 rpe	3-5 min	3 X 8	35% or 6-7 rpe	3-5 min	3 X 6	40% or 6-7 rpe	3-5 min	3 X 8	35% or 5-6 rpe	3-5 min	3 X 6	50% or 7-8 rpe	3-5 min	3 X 6	60% or 8-9 rpe	3-5 min
	Band-Assi-Jump	3 x 6	BW	3-5 min	3 X 6	BW	3-5 min	3 X 6	BW	3-5 min	3 X 6	BW	3-5 min	3 X 6	BW	3-5 min	3 X 6	BW	3-5 min
	Bench Press	3 X 8	60% or 5-6 rpe	3-5 min	3 X 6	70% or 6-7 rpe	3-5 min	3 X 4	80% or 6-7 rpe	3-5 min	3 X 6	70% or 5-6 rpe	3-5 min	3 X 4	85% or 7-8 rpe	3-5 min	3 X 3	90% or 8-9 rpe	3-5 min
	Plyo-Push-Up	3 x 6	BW	3-5 min	3 X 6	BW	3-5 min	3 X 6	BW	3-5 min	3 X 6	BW	3-5 min	3 X 6	BW	3-5 min	3 X 6	BW	3-5 min
	Med- Ball Push Slam	3x12	30% or 5-6 rpe	3-5 min	3 X 12	35% or 6-7 rpe	3-5 min	3 X 10	40% or 6-7 rpe	3-5 min	3 X 8	30% or 5-6 rpe	3-5 min	3 X 10	40% or 7-8 rpe	3-5 min	3 X 10	50% or 8-9 rpe	3-5 min
	Band-Assi-Push-Up	3 X 8	BW	3-5 min	3 X 8	BW	3-5 min	3 X 8	BW	3-5 min	3 X 8	BW	3-5 min	3 X 6	BW	3-5 min	3 X 6	BW	3-5 min
DAY 2	Bench Press	3 X 8	60% or 5-6 rpe	3-5 min	3 X 6	70% or 6-7 rpe	3-5 min	3 X 4	80% or 6-7 rpe	3-5 min	3 X 6	65% or 5-6 rpe	3-5 min	3 X 4	85% or 7-8 rpe	3-5 min	3 X 3	90% or 8-9 rpe	3-5 min
DAY 3	back squat	3 X 8	60% or 5-6 rpe	3-5 min	3 X 6	70% or 6-7 rpe	3-5 min	3 X 4	80% or 6-7 rpe	3-5 min	3 X 6	65% or 5-6 rpe	3-5 min	3 X 4	85% or 7-8 rpe	3-5 min	3 X 3	90% or 8-9 rpe	3-5 min
	CMJ	3 X 8	BW	3-5 min	3 X 8	BW	3-5 min	3 X 8	BW	3-5 min	3 X 8	BW	3-5 min	3 X 8	BW	3-5 min	3 X 5	BW	3-5 min
	Loaded trap bar jump	3 X 8	30% or 5-6 rpe	3-5 min	3 X 8	35% or 6-7 rpe	3-5 min	3 X 6	40% or 6-7 rpe	3-5 min	3 X 6	35% or 5-6 rpe	3-5 min	3 X 6	50% or 7-8 rpe	3-5 min	3 X 6	60% or 7-8 rpe	3-5 min
	Band-assi-jump	3 x 6	BW	3-5 min	3 X 6	BW	3-5 min	3 X 6	BW	3-5 min	3 X 6	BW	3-5 min	3 X 6	BW	3-5 min	3 X 6	BW	3-5 min
	Reverse Lunge	3 x 5		3-5 min	3 X 5	25% or 6-7 rpe	3-5 min	3 X 5	30% or 6-7 rpe	3-5 min	3 X 5	20% or 5-6 rpe	3-5 min	3 X 5	60% or 7-8 rpe	3-5 min	3 X 5	40% or 7-8 rpe	3-5 min
	Split squat jump	3 x 5	BW	3-5 min	3 X 5	BW	3-5 min	3 X 5	BW	3-5 min	3 X 5	BW	3-5 min	3 X 5	BW	3-5 min	3 X 5	BW	3-5 min
	Weighted split squat jump	3 x 5		3-5 min	3 X 5	20% or 6-7 rpe	3-5 min	3 X 5	30% or 6-7 rpe	3-5 min	3 X 5	25% or 5-6 rpe	3-5 min	3 X 5	35% or 7-8 rpe	3-5 min	3 X 4	45% or 7-8 rpe	3-5 min
	Band-assi-split squat jump	3 x 5	BW	3-5 min	3 X 5	BW	3-5 min	3 X 5	BW	3-5 min	3 X 5	BW	3-5 min	3 X 5	BW	3-5 min	3 X 4	BW	3-5 min

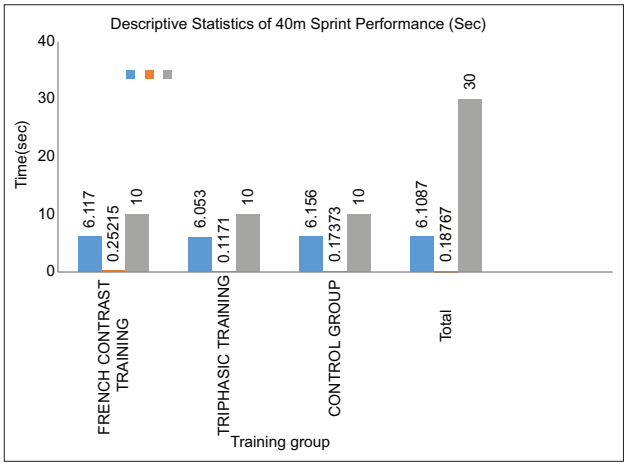

Figure 1: Mean score of 40 m sprint performance

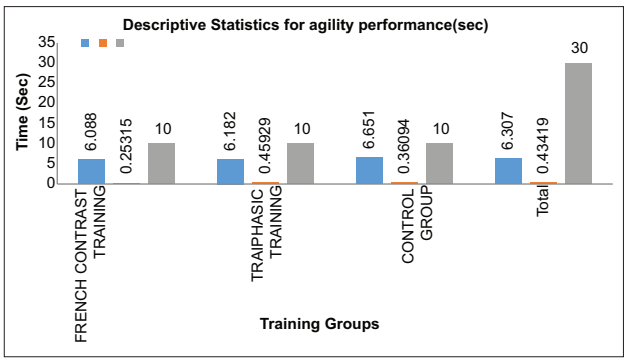

Figure 2: Mean scores of agility performance across the training group

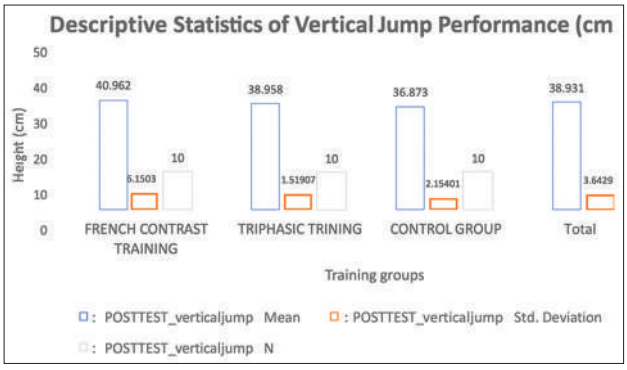

Figure 3: Mean scores of vertical jump performance characteristics

concentric propulsion, which is crucial for both jumping and changing direction (Dietz, 2012). These findings align with previous research demonstrating the efficacy of both contrast and phase-specific training for power-related tasks (Students, 2023; Kaya, 2022).

The lack of a significant difference between the two experimental groups suggests that, over 6 weeks, the choice of modality may be less important than the implementation of a structured, high-intensity resistance and power training program itself. Both methods provide a sufficient stimulus for robust adaptations in amateur athletes.

CONCLUSION

This study demonstrates that both FCT and TPT are viable and effective 6-week interventions for improving speed, agility, and vertical jump in male amateur athletes.

Practical Applications

Based on the results, strength and conditioning coaches can consider the following:

1. For linear speed enhancement: FCT may be the preferred option
2. For agility and vertical jump: Both FCT and TPT are highly effective, and the choice can be based on factors such as equipment availability, coach expertise, or athlete preference
3. General programming: Incorporating either of these structured, neuromuscular-focused training methods is superior to relying on sport-specific practice alone for developing key physical qualities in amateur athletes

Future research should investigate the long-term effects of these training modalities, their efficacy in female populations, and the potential for synergistic effects when combined periodized over a longer training cycle.

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Research Article

Leveraging the strategic impact of the false step on acceleration and sprint proficiency in collegiate football players

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ABSTRACT

Sprint acceleration and sprint proficiency are critical performance determinants in football, where repeated short-distance sprints and rapid movement initiation frequently influence match outcomes. Among various sprint initiation strategies, the false step technique has been proposed as a biomechanically advantageous movement for enhancing early acceleration. The purpose of the present study was to examine the effect of false step training on acceleration and sprint proficiency among collegiate football players. Fifteen male collegiate football players aged 17–22 years were randomly assigned to a false step training group, a forward step training group, and a control group (n = 5 each). The training intervention was conducted over a period of 4 weeks, with training sessions held 3 times/week. Acceleration and sprint proficiency were assessed using 5 m, 10 m, and 20 m sprint split times under linear, left, and right start conditions. Analysis of covariance was employed using pre-test scores as covariates. The results indicated that there were no statistically significant differences among the treatment groups across all acceleration and sprint proficiency variables ($P > 0.05$). Pre-test performance accounted for a substantial proportion of variance in post-test outcomes. It was concluded that 4 weeks of false step training did not result in significant improvements in acceleration or sprint proficiency when compared with forward step training or regular football training.

Keywords: Acceleration, False step, Football performance, Sprint initiation, Sprint proficiency

INTRODUCTION

Football is a high-intensity intermittent sport characterized by repeated bouts of sprinting, rapid acceleration, deceleration, and frequent changes of direction. Match analysis studies have demonstrated that decisive moments in football, such as goal-scoring opportunities, defensive recoveries, and transitions, often involve short sprints performed at high intensity. Consequently, the ability to accelerate quickly and achieve optimal sprint proficiency over short distances is considered a crucial physical attribute for football players.

Sprint performance in football is rarely expressed as maximal sprinting speed over long distances. Instead, players are required to repeatedly accelerate over distances ranging from 5 m to 20 m, often from varied starting positions. As a result, the initial phase of sprinting, particularly sprint initiation, has gained increasing attention among sports scientists, coaches, and strength and conditioning professionals.

Sprint initiation is a complex motor task involving neuromuscular coordination, optimal body positioning, and effective force application against the ground. Traditional coaching practices emphasize a forward step initiation strategy, where the athlete's first movement is directed forward toward the intended direction of travel. However, alternative techniques such as the false step have been proposed as potentially more effective methods for initiating acceleration.

The false step technique involves a brief backward or lateral movement of the foot before forward propulsion. Although this movement appears counterintuitive, biomechanical theories suggest that the false step may allow for improved positioning of the center of mass, enhanced utilization of the

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Table 1:

Training program				
Week	**Session**	**Warm-up (10 min)**	**Technique drills (30 min)**	**Cool-down (5 min)**
01-Feburary	1	3 min light jogging, 5 min dynamic stretches, 2 min high- intensity drills	Forward face position: - False step initiation: 3 sets of 5/leg, - Partner feedback: 3 sets of 5/leg, - Lateral position (left and right): - Lateral false step: 3 sets of 5/side, - Mirror drill: 3 sets of 5/side	Static stretching, deep breathing exercises
	2	3 min light jogging, 5 min dynamic stretches, 2 min high- intensity drills	Forward face position: - False step initiation: 3 sets of 6/leg, - Partner feedback: 3 sets of 6/leg, - Lateral position (left and right): - Lateral false step: 3 sets of 6/side, - Mirror drill: 3 sets of 6/side	Static stretching, deep breathing exercises
	3	3 min light jogging, 5 min dynamic stretches, 2 min high- intensity drills	Forward face position: - False step initiation: 3 sets of 7/leg, - Partner feedback: 3 sets of 7/leg, - Lateral position (left and right): - Lateral false step: 3 sets of 7/side, - Mirror drill: 3 sets of 7/side	Static stretching, deep breathing exercises
03-April	1	3 min light jogging, 5 min dynamic stretches, 2 min high- intensity drills	Forward face position: - Reactive false step: 4 sets of 5/leg, - Lateral position (left and right): - Lateral reactive step: 4 sets of 5/side, - change of direction drill: 4 sets of 5	Static stretching
	2	3 min light jogging, 5 min dynamic stretches, 2 min high- intensity drills	Forward face position: - Running routes from forward face position: 5 sets of 6, - Lateral position (left and right): - Lateral shuffles into blocking movements: 5 sets of 6/side, - Combo drills: Integrating forward and lateral steps with ball cues: 5 sets of 6	Static stretching, Light jogging or walking
	3	3 min light jogging, 5 min dynamic stretches, 2 min high- intensity drills	Forward face position: - Running routes from forward face position: 5 sets of 7, - Lateral position (left and right): - Lateral shuffles into blocking movements: 5 sets of 7/side, - Combo drills: Integrating forward and lateral steps with ball cues: 5 sets of 7	Static stretching, light jogging or walking

Table 2:

Descriptive statistics of 5 m split time of the linear start (s)			
Intervention	**Mean**	**SD**	***n***
False step	0.95	0.03391	5
Forward step	0.91	0.05385	5
Control	0.918	0.05357	5
Total	0.926	0.04793	15
Descriptive statistics of 10 m split time of the linear start (s)			
Intervention	**Mean**	**SD**	***n***
False step	1.756	0.07635	5
Forward step	1.56	0.19698	5
Control	1.636	0.06229	5
Total	1.6507	0.14434	15
Descriptive statistics of 20 m split time of the linear start (s)			
Intervention	**Mean**	**SD**	***n***
False step	3.064	0.14843	5
Forward step	2.872	0.1489	5
Control	2.916	0.09555	5
Total	2.9507	0.4988	15

SD: Standard deviation

stretch-shortening cycle, and more favorable force orientation during the initial push-off phase. These factors may contribute to improved acceleration and sprint proficiency.

Despite growing interest in the false step technique, empirical evidence supporting its effectiveness remains inconsistent. While some biomechanical analyses suggest potential advantages, training-based intervention studies have reported mixed findings. Furthermore, limited research has examined the effectiveness of false step training among collegiate football players, particularly within the Indian context.

Therefore, the purpose of the present study was to examine the effect of false step training on acceleration and sprint proficiency among collegiate football players. It was hypothesized that false step training would lead to greater improvements in sprint performance compared with forward step training and control conditions.

REVIEW OF LITERATURE

Acceleration performance is influenced by multiple physiological and biomechanical factors, including muscular

Table 3:

Adjusted mean of 5 m split time of the linear start (s)				
95% Confidence interval				
Treatment	**Mean**	**Standard error**	**Lower bound**	**Upper bound**
False step	0.916[a]	0.016	0.882	0.951
Forward step control	0.924[a]	0.014	0.893	0.955
	0.938[a]	0.014	0.906	0.969
Adjusted mean of 10 m split time of the linear start (s)				
95% confidence interval				
Treatment	**Mean**	**Standard error**	**Lower bound**	**Upper bound**
False step forward step	1.638[a]	0.017	1.601	1.674
Control	1.639[a]	0.014	1.605	1.673
	1.675[a]	0.015	1.643	1.707
Adjusted mean of 20 m split time of the linear start (s)				
95% confidence interval				
Treatment	**Mean**	**Standard error**	**Lower bound**	**Upper bound**
False step	2.932[a]	0.023	2.881	2.984
Forward step control	2.931[a]	0.02	2.887	2.976
	2.989[a]	0.021	2.943	3.034

strength, power, neuromuscular coordination, and sprint technique. Research has consistently highlighted the importance of horizontal force production during the early acceleration phase. Athletes who can effectively orient ground reaction forces in a horizontal direction tend to achieve greater acceleration.

Several studies have investigated sprint initiation mechanics. Mann *et al*. emphasized that effective sprint initiation requires rapid force production and appropriate body lean to overcome inertia. Similarly, Delecluse *et al*. reported that improvements in sprint performance are closely associated with the ability to generate force quickly during the initial phase of sprinting.

The false step technique has been examined primarily from a biomechanical perspective. Some researchers have suggested that the backward movement associated with the false step may facilitate greater pre-activation of the lower limb musculature, particularly the gluteal and hamstring muscles. This pre-activation may enhance force production during the subsequent forward push-off.

However, empirical findings regarding false step training interventions remain inconclusive. While certain studies have reported marginal improvements in acceleration metrics, others

Table 4:

Tests of between-subjects effects of 5 m split time of the linear start						
Dependent variable: Linear start 5 m post (s)						
Source	**Type I Sum of squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Pre-test treatment error	0.021	1	0.021	22.348	0.001	0.67
Total	0.001	2	0	0.471	0.637	0.079
	0.01	11	0.001			
	0.32	14				
Tests of between-subjects effects of 10 m split time of the linear start						
Dependent variable: Linear start 10 m post (s)						
Source	**Type I Sum of squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Pre-test treatment error	0.276	1	0.276	274.583	0	0.961
Total	0.004	2	0.002	2.105	0.168	0.277
	0.011	11	0.001			
	0.292	14				
Tests of between-subjects effects of 20 m split time of the linear start						
Dependent variable: Linear start 20 m post (s)						
Source	**Type I Sum of squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Pre-test treatment error	0.284	1	0.284	150.64	0	0.932
Total	0.01	2	0.005	2.519	0.126	0.314
	0.021	11	0.002			
	0.314	14				

Table 5:

Descriptive statistics of 5m split time of the left start (s)			
Intervention	**Mean**	**SD**	***n***
False step	0.89	0.0728	5
Forward step	0.892	0.09284	5
Control	0.884	0.05128	5
Total	0.8887	0.06885	15
Descriptive statistics of 10m split time of the left start (s)			
Intervention	**Mean**	**SD**	***n***
False step	1.674	0.06465	5
Forward step	1.668	0.03347	5
Control	1.612	0.05167	5
Total	1.6513	0.05579	15
Descriptive statistics of 20 m split time of the left start (s)			
Intervention	**Mean**	**SD**	***n***
False step	2.99	0.1	5
Forward step	2.898	0.10426	5
Control	2.86	0.0946	5
Total	2.916	0.10822	15

SD: Standard deviation

Table 6:

Adjusted mean of 5 m split time of the left start (s)				
95% Confidence interval				
Treatment	**Mean**	**Standard error**	**Lower bound**	**Upper bound**
False Step	0.877[a]	0.009	0.857	0.898
Forward step control	0.892[a]	0.009	0.871	0.913
	0.897[a]	0.009	0.876	0.917
Adjusted mean of 10 m split time of the left start (s)				
95% Confidence interval				
Treatment	**Mean**	**Standard error**	**Lower bound**	**Upper bound**
False step forward step	1.637[a]	0.012	1.61	1.663
Control	1.663[a]	0.011	1.639	1.686
	1.655[a]	0.012	1.627	1.682
Adjusted mean of 20 m split time of the left start (s)				
95% Confidence interval				
Treatment	**Mean**	**Standard error**	**Lower bound**	**Upper bound**
False step forward step	2.897[a]	0.016	2.862	2.932
Control	2.923[a]	0.014	2.894	2.953
	2.928[a]	0.015	2.895	2.96

SD: Standard deviation

have found no significant differences between false step and traditional forward step techniques. These inconsistencies may be attributed to differences in training duration, participant characteristics, and methodological approaches.

In football-specific contexts, sprint initiation often occurs under reactive and unpredictable conditions. Therefore, understanding whether specific sprint initiation techniques translate into meaningful performance improvements is of practical importance. The present study aimed to address this gap by experimentally examining the effect of false step training on acceleration and sprint proficiency among collegiate football players.

MATERIALS AND METHODS

Participants

Fifteen male collegiate football players aged between 17 and 22 years participated in the study. All participants were actively involved in collegiate-level football training and competition. Players were free from musculoskeletal injuries at the time of the study and provided informed consent before participation.

Research Design

A randomized pre-test–post-test control group design was employed. Participants were randomly assigned to one of three groups: False step training group, forward step training group, or control group, with five players in each group. Random assignment was used to ensure equivalence among groups at baseline.

Training Intervention

The training intervention was conducted over a period of 4 weeks, with training sessions held 3 times/week.

- The false step training group performed sprint initiation drills emphasizing the false step technique.
- The forward step training group performed sprint initiation drills emphasizing a traditional forward step technique.
- The control group continued with their regular football training without additional sprint initiation drills.

Training volume and intensity were matched between the experimental groups to ensure that differences in outcomes could be attributed to the sprint initiation technique rather than training load.

Criterion Measures

Acceleration and sprint proficiency were assessed using 5 m, 10 m, and 20 m sprint split times. Testing was conducted under three start conditions: Linear start, left start, and right start. Standardized sprint testing procedures were followed, and sufficient rest was provided between trials to minimize fatigue.

Statistical Analysis

Descriptive statistics (mean and standard deviation) were calculated for all variables. Analysis of covariance (ANCOVA)

Table 7:

Tests of between-subjects effects of 5 m split time of the left start						
Dependent variable: Left start 5 m Post (s)						
Source	**Type I Sum of squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Pre-test treatment error	0.061	1	0.061	139.372	0	0.927
Total	0.001	2	0.001	1.181	0.343	0.177
	0.005	11	0			
	0.066	14				
Tests of between-subjects effects of 10 m split time of the left start						
Dependent variable: Left Start 10 m Post (s)						
Source	**Type I Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Pre-test treatment error	0.036	1	0.036	42.496	0	0.85
Total	0.002	2	0.001	1.374	0.293	0.2
	0.006	11	0.001			
	0.044	14				
Tests of between-subjects effects of 20 m split time of the left start						
Dependent variable: Left start 20 m Post (sec)						
Source	**Type I Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Pre-test treatment error	0.152	1	0.152	170.919	0	0.94
Total	0.002	2	0.001	0.97	0.409	0.15
	0.01	11	0.001			
	0.164	14				

Table 8:

Descriptive statistics of 5 m split time of the right start (s)			
Intervention	**Mean**	**SD**	***n***
False step	0.898	0.075	5
Forward step	0.936	0.0344	5
Control	0.898	0.0497	5
Total	0.911	0.0547	15
Descriptive statistics of 10m split time of the right start (s)			
Intervention	**Mean**	**SD**	***n***
False step	1.64	0.09165	5
Forward step	1.664	0.03912	5
Control	1.65	0.04359	5
Total	1.6513	0.05902	15
Descriptive statistics of 20 m split time of the right start (s)			
Intervention	**Mean**	**SD**	***n***
False step	2.976	0.13012	5
Forward step	2.942	0.08927	5
Control	2.896	0.10114	5
Total	2.938	0.10578	15

SD: Standard deviation

was employed to examine post-test differences among groups, with pre-test scores treated as covariates. The level of significance was set at $P < 0.05$.

RESULTS

The results of the study indicated that there were no statistically significant differences among the false step training group, forward step training group, and control group across all acceleration and sprint proficiency variables when pre-test scores were controlled.

For the linear start 5 m sprint, ANCOVA revealed no significant treatment effect, $F(2, 11) = 0.471$, $P = 0.637$. For the linear start 10 m sprint, no statistically significant difference was observed, $F(2,11) = 2.105$, $P = 0.168$. For the linear start 20 m sprint, treatment effects were not statistically significant, $F(2,11) = 2.519$, $P = 0.126$.

Similarly, ANCOVA results for left start and right start conditions across 5 m, 10 m, and 20 m sprint distances demonstrated no statistically significant differences among the groups ($P > 0.05$). In all analyses, pre-test sprint performance

Table 9:

Adjusted mean of 5 m split time of the right start (s)				
	95% Confidence interval			
Treatment	**Mean**	**Standard error**	**Lower bound**	**Upper bound**
False step forward step	0.893[a]	0.014	0.863	0.923
Control	0.912[a]	0.014	0.881	0.943
	0.927[a]	0.015	0.895	0.959
Adjusted mean of 10 m split time of the right start (s)				
	95% Confidence interval			
Treatment	**Mean**	**Standard error**	**Lower bound**	**Upper bound**
False Step	1.627[a]	0.012	1.599	1.654
Forward Step Control	1.648[a]	0.012	1.62	1.675
	1.680[a]	0.013	1.651	1.708
Adjusted mean of 20 m split time of the right start (s)				
	95% confidence interval			
Treatment	**Mean**	**Standard error**	**Lower bound**	**Upper bound**
False step forward step	2.915[a]	0.02	2.871	2.96
Control	2.936[a]	0.019	2.895	2.978
	2.962[a]	0.02	2.917	3.007

Table 10:

Tests of between-subjects effects of 5 m split time of the right start						
Dependent variable: Right Start 5 m Post (s)						
Source	**Type I Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Pre-test treatment error	0.029	1	0.029	31.738	0	0.743
Total	0.003	2	0.001	1.485	0.269	0.213
	0.01	11	0.001			
	0.042	14				
Tests of Between-Subjects Effects of 10m split time of the right start						
Dependent variable: Right start 10 m Post (s)						
Source	**Type I Sum of squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Pre-test treatment error	0.034	1	0.034	45.346	0	0.805
Total	0.006	2	0.003	4.154	0.045	0.43
	0.008	11	0.001			
	0.049	14				
Tests of between-subjects effects of 20 m split time of the right start						
Dependent variable: Right start 20 m post (s)						
Source	**Type I Sum of squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Pre-test treatment error	0.133	1	0.133	75.417	0	0.873
Total	0.004	2	0.002	1.182	0.343	0.177
	0.019	11	0.002			
	0.157	14				

SD: Standard deviation

accounted for a substantial proportion of variance in post-test scores.

DISCUSSION

The primary finding of the present study was that 4 weeks of false step training did not produce statistically significant improvements in acceleration or sprint proficiency among collegiate football players. These findings align with previous research suggesting that short-term sprint technique interventions may have limited effectiveness when applied in isolation.

One possible explanation for the lack of significant improvement is the relatively short duration of the intervention. Sprint performance adaptations, particularly those related to acceleration, may require longer training periods and the integration of strength and power development. In addition, collegiate football players often possess a moderate to high baseline level of sprint ability, which may reduce the magnitude of observable improvements over short intervention periods.

The strong influence of pre-test performance on post-test outcomes indicates that baseline sprint ability plays a crucial role in determining training responsiveness. Players with higher initial sprint proficiency may require more individualized or advanced training stimuli to achieve further improvements.

From a practical perspective, the findings suggest that while the false step technique may have biomechanical relevance, its isolated application over a short period does not appear to significantly enhance sprint performance in collegiate football players. Coaches should therefore consider incorporating sprint technique training within a comprehensive strength and conditioning framework rather than relying solely on technique-focused interventions.

CONCLUSION

The study concluded that 4 weeks of false step training did not significantly improve acceleration or sprint proficiency among collegiate football players when compared with forward step training or regular football training. These findings highlight the importance of evidence-based evaluation of sprint initiation techniques and suggest that short-term technique-focused interventions may have limited effectiveness in isolation. Future research should examine longer intervention durations and combined training approaches to better understand the role of sprint initiation strategies in football performance.

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Research Article

The effect of the technology-enhanced active learning model on learning some basketball skills among students of the college of physical education and sport sciences

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ABSTRACT

This study aimed to evaluate the impact of the technology-enhanced active learning model on the development of basic skills in basketball among first-stage students at the faculty of physical education and sport sciences – University of Babylon for the academic year (2023–2024), while comparing the performance between the experimental and control groups using the experimental method and designing the two equal groups with a pre- and post-test. The research sample consisted of 32 students, who were evenly divided into two groups, and the study focused on the skills of tapping, chest shifting, and peaceful aiming, with pre- and post-tests to measure the acquisition of skills. The researcher applied the educational program to the experimental group using 12 educational modules over a period of 6 weeks, while integrating technology to promote interaction, active participation, and teamwork. The results showed that the model had a clear positive effect on improving basic basketball skills, as well as enhancing collaboration, self-confidence, and the exchange of ideas among students, confirming the validity of the model as an effective tool for developing practical athletic performance. The research indicates that the adoption of modern and interactive educational methods in physical education contributes significantly to raising the efficiency of physical education and expanding the scope of innovation in teaching practical skills.

Keywords: Active learning, Basketball, Technology reinforcement

THE INTRODUCTION OF THE RESEARCH AND ITS THEORETICAL AND PRACTICAL IMPORTANCE

Research Introduction

The world is witnessing rapid transformations at all levels, and the educational field has had a clear share of these transformations, as a result of the concerted efforts of researchers and specialists in developing teaching methods and raising the quality of the educational process. This development has been reflected in physical education in particular, where the adoption of modern educational models has become a necessity to achieve the acquisition of practical skills among learners, and to enhance their interaction and effective contribution to the educational process. One of the most prominent of these models is active learning supported by technology, which represents an educational framework that focuses on the role of the learner, who is active in building knowledge, based on the principles of constructivist theory, which holds that learning occurs through interaction, practice, and practical experience.

Active technology-enhanced learning relies on investing time in an effective manner, employing the previous experiences of learners, which contributes to consolidating knowledge and the possibility of retrieving it when needed, and works to create an interactive learning environment in which both the teacher and the learner play an integrated role toward achieving the goals of the educational process. This model allows the integration of technology as a supportive means to facilitate learning, deepen understanding, and stimulate critical thinking, which raises the efficiency of the educational process and makes it more dynamic and flexible.

Importance of the Research

Basketball is one of the most widely used sports, due to its ability to be practiced by different age and social groups, as well as the diversity of basic skills that form the main pillar of its correct performance. Studies have confirmed that mastering these skills requires a structured educational program that relies

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on modern methods to motivate the learner and provide him with the ability to actually apply the skills in an integrated and sequential manner.

The importance of this study lies in the design of an integrated educational program that adopts active learning enhanced by technology, with the aim of developing the basic skills in basketball among students, and achieving a high level of technical performance. The study also seeks to provide a modern educational model that can be used in the development of the sports educational process, in line with the requirements of the digital age and modern trends in teaching practical skills.

Research Problem

Despite the continuous development in sports education methods, many students face difficulty in acquiring the basic skills of basketball in an integrated and effective manner, due to the adoption of traditional methods in sports education that focus on theoretical presentation and limited practice, without providing an interactive learning environment that encourages active participation and hands-on learning.

Recent studies indicate that the use of technology-enhanced active learning models contributes to enhancing students' understanding, improving their practical skills, and increasing their ability to apply knowledge in actual play situations. However, the application of these models in sports education, especially in basketball, is still limited in schools and universities, creating a gap between the theoretical potential of these models and the reality of educational practice.

Accordingly, there is a need to study the impact of an educational program based on active learning enhanced by technology on the development of basic basketball skills in students, to determine the effectiveness of this model in improving skill performance and developing sports teaching methods in accordance with the requirements of the modern era.

Research Objectives

The research aims to:

- Designing an educational program based on active learning powered by technology to develop essential skills in basketball
- Measure the impact of the program on improving students' performance in basic basketball skills
- Providing scientific recommendations for employing active learning enhanced by technology in sports education to contribute to raising the efficiency of the educational process and improving its outcomes.

Research Hypotheses

- There are statistically significant differences between the results of the experimental group's pre- and post-test in some of the basic basketball skills of students (Smith and Jones, 2020).
- There are statistically significant differences between the results of the experimental and control groups in the post-tests of some basic basketball skills in students (Brown, 2019).

Research Areas

Human field

Students of the First Stage at the Faculty of Physical Education and Sport Sciences – University of Babylon for the Academic Year (2023–2024).

Temporal domain

The duration of the study extends from November 30, 2023, to February 11, 2024.

Spatial domain

Outdoor basketball court at the Faculty of Physical Education and Sport Sciences – University of Babylon.

Definition of Terms

Technology-enhanced active learning model

It is an educational model based on cognitive theory and a constructivist approach, which aims to enable the learner to acquire concepts and the possibility of retrieving them in practical application in the future, in addition to investing time in learning more content through the implementation of practical and interactive activities (Johnson *et al*., 2019).

RESEARCH METHODOLOGY AND FIELD PROCEDURES

Research Methodology

The experimental method was used by designing the two equal groups (experimental and control) with pre- and post-tests, due to the accuracy it provides in measuring the impact of the educational program (Creswell, 2018).

Research Population and Sample

The research population consisted of 275 students in the first stage of the Faculty of Physical Education and Sport Sciences – University of Babylon for the academic year (2023–2024). A research sample of 32 students, divided equally into two groups: Experimental and control, each group included 16 students.

Devices and Tools Used

- A Dell computer to support educational software and assessment
- An electronic scientific calculator for performing calculations

- Digital stopwatch to adjust the time of exercises and tests
- Eight baskets
- A refereeing whistle to guide students during exercises
- Meter tape measure to determine distances and paths
- Six indicators to locate movement and training.

Field Research Procedures

Identify the basic skills of basketball

The researcher relied on the curriculum of the first stage at the Faculty of Physical Education and Sport Sciences – University of Babylon for the academic year (2023–2024) to determine the basic skills targeted in the study. The skills that represent the main pillars of the performance of the basketball game in the students, namely the battering, the pectoral shift, and the peaceful shooting, were selected as representing the level of technical performance required for students at the beginning of the undergraduate stage.

Preparation and selection of skill tests

The researcher prepared an assessment questionnaire that included three suggested tests for each of the target skills. These tests were then presented to nine basketball experts to determine their relative importance and suitability for the study objectives. The test with the highest relative weight was selected as the most appropriate to evaluate the students' performance.

Description of Skill Tests

First: Test the drumming skill with the change of direction

- The purpose of the test: to measure the student's ability to control the ball while tapping with directional changes, and to assess the speed of performance and motor coordination (Williams and Hodges, 2022)
- Tools used: Basketball, 5 marks, digital stopwatch, basketball court.
- Performance method
  - Five indicators are placed on a straight path, with a distance of 2 m between each indicator and the next.
  - The student stands behind the starting line holding the ball
  - At the start signal, the student taps and zigzags between the signs until the finish line is reached, passing through all the signs without stopping.
- Recording: The time taken is recorded in seconds, and the shortest amount of time is considered the best performance
- Instructions: Continue to play without holding the ball, do not drop the marks, allow two attempts, and score the best result.

Second: Chest shift skill test against the wall

- Purpose of the test: Measure the accuracy of the thoracic handling and the student's ability to direct the ball toward a specific goal (Johnson *et al*., 2021)
- Tools used: Basketball, wall, wall painted square (1 × 1 m), tape measure.
- Performance method
  - The student stands 3 m away from the wall
  - Perform 10 chest maneuvers toward the square drawn on the wall, the ball continues to bounce, and the performance is completed.
- Scoring: Accurately counts the number of balls hitting the square out of 10 attempts.
- Instructions: Adhere to the set distance, apply the correct technique, and count only balls within the box.

Third: Peaceful shooting skill test for 30 s

- Purpose of the test: To measure the speed and accuracy of students' peaceful aiming performance (Kim and Lee, 2022)
- Tools used: Legal basketball, stopwatch, basketball court.
- Performance method:
  - The student stands holding the ball in front of the basket
  - At the start signal, it begins with a patting and peaceful aim, with the ball recovering and reperforming within 30 s.
- Registration: The number of successful peaceful corrections is calculated during the specified time period
- Instructions: Adherence to the correct technical steps can be performed from the right or left side, and only successful corrections are counted.

Exploratory Experiment

The exploratory experiment was carried out on Monday, December 20, 2023, on a sample of 10 students from the first stage, who did not participate in the main study, and were randomly selected from the research community.

- Objectives of the exploratory experiment
  - Determine the time needed to perform each test and all tests combined
  - Identify the obstacles and difficulties that the researcher may face during the main experiment, to overcome them before the official application.

Scientific Foundations of Tests

Validity of the tests

The authenticity of the content was verified by presenting the three skill tests (tapping, pectoral shift, and peaceful shooting) to a group of experts in basketball, measurement, and teaching techniques. The tests were verified for compatibility with the objectives of the study, ensuring their scientific credibility (Cote *et al*., 2021).

Stability of tests

Stability was measured using the application and reapplication method on the same sample of the survey experiment on two similar days (December 20, 2023, and December 27, 2023), while maintaining the same temporal and spatial conditions. The simple correlation coefficient (Pearson) was calculated

Table 1: Results of the expert evaluation of the candidate tests and the relative importance of each skill

Skills	*t*	Tests	Grades achieved	Relative importance (%)	Relative weight (%)	Selection
Patting skill	1	Curvy tapestry test between pointers	48	53.30	25.90	Unacceptable
	2	Round-trip quick tapping test	53	58.90	28.70	Unacceptable
	3	Tamping test with changing direction	84	93.30	45.40	Acceptable
Thoracic shift skill	1	Chest handling accuracy test against the wall	87	96.70	44.20	Acceptable
	2	30-s chest handling speed test	58	64.40	29.40	Unacceptable
	3	Thoracic handling of movement	52	57.80	26.40	Unacceptable
Peaceful aim skill	1	30-s peaceful aiming test	90	100	52.60	Acceptable
	2	Peaceful aiming test from both sides	42	46.70	24.60	Unacceptable
	3	Peaceful aiming test after tapping	39	43.30	22.80	Unacceptable

for each test, and the results showed that the tests have high stability, as shown in Table 2.

Pre-Tests

The pre-tests were carried out on all members of the research sample (experimental and control groups), which were 32 students of the first stage, on Wednesday, December 29, 2023.

The data were carefully collected and recorded in specially designed forms to provide an accurate database to measure students' levels before the implementation of the training program, in preparation for statistical analysis using appropriate statistical programs (Field, 2018; Hopkins, 2020).

The Parity of the Two Research Groups

To evaluate the equivalence of the experimental and control groups before starting the main experiment, the researcher extracted the mean and standard deviation of the performance of the members of each group in the pre-tests of the target basketball skills: tapping, pectoral shift, and peaceful shooting.

The t-test of independent samples was also used to verify the existence of any statistically significant differences between the two groups in the measured variables. The results showed that the differences between the medians were not significant, confirming the equivalence of the two groups in terms of basic skill levels before the implementation of the educational program, as shown in Table 3 (Field, 2018; Hopkins, 2020).

Tutorial using the Technology-Enhanced Active Learning Model

An educational program was prepared with the active learning model enhanced by technology on the experimental group, where (12) educational units for basketball skills (tapping, chest shift, and peaceful shooting) were applied divided into (6) weeks at the rate of two units per week, starting from Wednesday (January 03, 2024) until Monday (December 12, 2024). Each module was 90 min long, and

Table 2: Stability coefficients for skill tests

Skills	Stability coefficient	Significance value
Patting	0.872	0.000
Thoracic shift	0.756	0.001
Peaceful aim	0.689	0.004

the module was divided into three main sections to ensure that students are prepared gradually before moving on to core activities.

Preparatory section (20 min)

- Organization (5 min): Prepare the necessary tools and check that all students are present in preparation for the start of class
- General warm-up (5 min): Perform exercises that move all parts of the body, such as brisk walking and jogging, to prepare the body for physical activity
- Special warm-up (10 min): Perform special exercises using a ball, aimed at preparing students for basic technical activities in the main section of the educational unit.

Main section (65 min)

The main section is divided into two educational and applied sections, as follows:

The researcher introduced the curriculum of this model in the main part according to the steps of the active learning model enhanced by technology, as follows.

First: Educational part (25 min)

Objective

The objective of the study was to explain theoretical skills and knowledge with the use of technological media.

Steps

1. A short video demonstration of tapping, chest handling, and peaceful aiming techniques (3–5 min per skill)

Table 3: The equivalence of the two research groups (control and experimental) in the studied variables

Skills	Unit of measurement	Calculated *t*-value	Control group		Experimental group		Significance value	Type of indication
			Going on	Going to	Going on	Going to		
Patting	Degree	0.778	0.772	6.063	0.577	6.250	0.443	Insignificant
Thoracic shift	Second	1.039	0.713	11.929	0.626	12.179	0.307	Insignificant
Peaceful aim	Degree	0.785	0.806	3.3750	0.512	3.563	0.439	Insignificant

2. Use a tablet or monitor to display interactive illustrations or simulate movements
3. A short interactive discussion with the students about common mistakes and how to correct them (5 min).

Techniques used
- Short tutorial videos
- 3D simulation of skills
- Interactive on-screen questions (e.g. Kahoot or Quizizz).

Second: The applied part (approximately 40 min)
Objective
Practice skills in practice with real-time monitoring and correction of errors using technology.

Steps
1. Training stations for each skill
   - Al-Tabataba station
   - Chest handling station
   - Peaceful aim station
2. Students practice each skill for a set duration (10–12 min/stop)
3. Active technology-enhanced learning
   - Record a short video of each student during the performance (using a tablet or camera)
   - View the video directly to the student for immediate error correction
   - Providing immediate feedback from the teacher using a monitor or tablet.

Features
- Promote engagement and interaction
- Instant error correction
- Increase motivation with technology

At this stage, the basic principles of the model are applied by following the following specific steps
1. Divide the students into eight binary groups, each group given a serial number
2. Assign a task to each student in each group (passer, recipient)
3. The skill is applied by odd number totals, and even number totals are monitored
4. In order to refine their knowledge, students were allowed to ask questions about the skill to the groups that would apply the skill
5. Exchange locations between groups so that even number totals are applied and odd number totals are monitored
6. Repeat the exercises according to this step several times.

Third: The concluding section (5 min)
It includes a small game for the purpose of reducing the effort, spreading excitement, suspense and enthusiasm among the students, and ending the lesson and leaving.

Post-Tests
The post-tests were conducted on all members of the research sample (experimental and control groups) of 32 students from the first stage, on Wednesday, February 14, 2024.

All the same conditions and procedures as those applied in the pre-tests were adhered to ensure objectivity and credibility in data collection.

The results of the performance were recorded in forms specially prepared for this purpose, with the aim of providing a structured database to enable the researcher to analyze the results statistically accurately.

Statistical Methods
Statistical Package for the Social Sciences software was used to process the data and extract the statistical results according to the following tools:
- Calculate the mean of each test to determine the overall performance of students
- Calculate the standard deviation to measure the performance dispersion around the mean
- Using the Pearson correlation coefficient to measure the degree of correlation between different variables
- Apply the *t*-test of independent samples to compare the performance of the experimental and control groups
- Apply a *t*-test for correlated samples to compare the performance of the same group between pre- and post-tests (Field, 2018; Pallant, 2020).

PRESENTING, ANALYZING AND DISCUSSING THE RESULTS

Presentation and Analysis of the Results of the Pre- and Post-Tests of the Experimental Group
Table 4 presents the performance averages, standard deviations, and t-test values calculated for basic basketball skills in the

experimental group, for both pre- and post-tests, allowing the assessment of the change in performance after the implementation of the technology-enhanced active learning program.

The results indicate a clear improvement in performance after the implementation of the educational program, as the post-tests showed an increase in the scores of the battering and peaceful aiming and an improvement in the time of the chest shift. The *t*-test shows that the differences between the pre- and post-tests are statistically significant in favor of the post-tests, as the value of the significance level was <0.05, which confirms the impact of the program on the development of students' skills.

Analysis of the Results of the Pre- and Post-Tests of the Control Group

Although there is some improvement in the results of the post-tests compared to the pre-test tests, this improvement is limited compared to the experimental group. The statistical values of the (*t*) test showed that the differences between the pre-test and post-tests were significant, reflecting the effect of natural learning or traditional training on the performance of students, but less effective than the educational program applied to the experimental group.

Analysis of the Results of the Post-Tests of the Two Groups

The results show that the experimental group outperformed the control group in all skills, as it scored higher scores for tapping and peaceful aiming, and a better time in the chest shift. The *t*-tests of the independent samples showed that these differences were statistically significant at the level of 0.05, which confirms the effectiveness of the technology-enhanced active learning program in improving students' technical performance compared to the traditional method.

DISCUSSION OF THE RESULTS

The results showed in [Tables 4-6] that there were significant differences between the pre- and post-tests of the members of the two groups, as well as between the post-tests of the experimental and control groups, in terms of the three basketball skills: tapping, chest handling, and peaceful aiming.

The researcher attributes the significant differences of the control group members to several variables and influences that interfered in the learning process to the role of feedback from the teacher that was given during the performance of the exercises or after the end of the lesson, and the traditional methods were sometimes enhanced by using short videos

Table 4: The average performance and standard deviations of the experimental group in the pre- and post-tests of basic basketball skills

Skills	Unit of Measurement	Pre-test		Post-testing		Calculated (*t*) value	Significance value	Type of indication
		Going on	Going to	Going on	Going to			
Patting	Degree	0.577	6.250	0.793	12.312	31.416	0.000	Moral
Thoracic shift	Second	0.626	12.179	0.745	8.616	15.974	0.000	Moral
Peaceful Aim	Degree	0.512	3.563	0.911	6.813	19.030	0.000	Moral

Table 5: The average performance and standard deviations of the control group in the pre- and post-tests

Skills	Unit of measurement	Pre-test		Post-testing		Calculated (*t*) value	Significance value	Type of indication
		Going on	Going to	Going on	Going to			
Patting	Degree	0.772	6.063	0.964	10.562	34.857	0.000	Moral
Thoracic shift	Second	0.713	11.929	0.902	9.741	7.892	0.000	Moral
Peaceful aim	Degree	0.806	3.375	0.500	5.625	15.588	0.000	Moral

Table 6: The comparison of the performance of the experimental and control groups in the post-Tests of basketball skills

Skills	Unit of measurement	Control group		Experimental group		Calculated (*t*) value	Significance value	Type of indication
		Going on	Going to	Going on	Going to			
Patting	Degree	0.964	10.562	0.793	12.312	5.607	0.000	Moral
Thoracic shift	Second	0.902	9.741	0.745	8.616	3.845	0.001	Moral
Peaceful Aim	Degree	0.500	5.625	0.911	6.813	4.572	0.000	Moral

to illustrate the correct performance or compare the errors. (Al-Deiri and Blanket, 1987) confirmed that "after the end of the application period and preparation for the end of the lesson, the teacher corrects the mistakes for the students."

The teacher's style of guidance during the exercises also created an atmosphere of excitement, suspense, and competition. The use of video displays or three-dimensional simulations of skills during the explanation helped students to see the correct movements before simulating them in practice, which (Abu Harja *et al*., 2000) pointed out that the use of exercises and games activates the nervous and physical system, contributes to the development of the psychological aspects of students, and generates motivation.

Studies have shown that high motivation increases the desire to repeat and practice, which enhances learning. (Al-Issawi, 2013) stated that "the stronger the learner's motivation, the stronger his desire toward the activity leading to learning."

One of the most important factors in effective learning is the repetition of exercises, as repetition helped to consolidate skills. In some classes, small performance cameras were used to evaluate students after training, which (Shalash and Sobhi, 1994) emphasized that "continuous practice and repetition are necessary in the learning process."

As for the significant differences in the experimental group, the researcher attributed them to the use of the technology-enhanced active learning model (TEAL), where educational technologies played a central role in enhancing learning by increasing attention and continuous interaction, as students used interactive screens, tablets, and 3D simulations of educational videos to illustrate skills, which made them more attentive and engaged in the lesson. Al-Huwaidi (2005) also pointed out that "active learning methods aim to teach the learner how to learn, how to think, and how actively participates.

Furthermore, the students' performance during the exercise was recorded using tablets and small digital cameras, and then the performance was presented to the students to correct mistakes immediately, which promoted self-learning and improved skill performance, which (Melhem, 2001) confirmed that this method contributes to the development of individual and motor abilities of students.

The role of technology emerged through the use of interactive boards and digital collaboration programs to exchange feedback between students, which helped to understand skills more quickly and improve performance, which (Al-Ahad and Youssef, 2003) pointed out that "the teamwork of learners and the exchange of opinions to understand the skill enhances learning."

Furthermore, the participation of students in collaborative groups and the use of digital performance measurement applications or video recording increased the effectiveness of learning and improved skill performance, and this is consistent with (Zaghloul *et al*., 2001) that a teacher who walks among students and guides them using direct feedback and technological tools helps students learn from each other and provides the opportunity for effective participation.

The results of the study showed that, Tutorial Using the technology-enhanced active learning model, students have moved from a passive, receptive to an active dynamic one, thanks to assistive technology tools Interactive screens for displaying movements and exercises, a tablet for recording performance, video review, 3D simulations of educational videos, and digital collaboration programs to share feedback between students.

CONCLUSION AND RECOMMENDATIONS

Conclusion

- The active learning model enhanced by technology has a positive effect on the learning of basketball skills (tapping, pectoral shift, peaceful shooting)
- Teamwork and collaboration between students increased the learning process, self-confidence, and the exchange of ideas
- The technological enhancement has greatly helped in the development of basketball skills (tapping, pectoral shift, peaceful shooting) of the control group
- The experimental group outperformed the control group in learning basketball skills (tapping, chest shift, peaceful shooting).

Recommendations

- Applying a technology-enabled active learning model in teaching the technical performance of basketball skills due to its effectiveness in providing an interactive learning environment and enhancing the acquisition of practical skills for students.
- Encourage the use of modern educational models in all physical education lessons, while moving away from traditional methods that may limit the development of students' technical and physical skills.
- Organizing training courses and workshops for teachers and students, with the aim of identifying the effectiveness of modern educational models and ways to employ them practically to promote active learning and applied skills.
- Conducting other similar studies using the technology-enhanced active learning model on different samples and other games.

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Research Article

Assessment of selected physical performance parameters among elite and sub-elite softball players

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ABSTRACT

Purpose: This study was to compare the selected physical fitness parameters of elite and sub-elite softball players. **Materials and Methods:** The subjects of the study are the softballers who represent the All India inter-university level for elite players and the zonal level players for sub-elite players. A total of 20 male softballers, 10 from each of the elite and sub-elite groups, had their physical assessments of flexibility, speed, and agility conducted to collect the necessary data. The statistical significance level was set at $P < 0.05$, and an independent t-test was employed to compare. **Results:** The result revealed that there was no significant difference between elite and sub-elite softball players, as calculated values of $t = 0.10$, 0.55, and 0.09 are less than the critical table value of $t = 2.10$ at a 0.05 level of confidence for two-tailed tests ($P > 0.05$). The reason might be due to games' high demand for physical and physiological efficiency. Flexibility, agility and speed are very important in this game for hitting the ball and running base to base and also in fielding, pitching and catching. **Conclusion:** An insignificant difference in physical performance parameters in the game. The game depends on hit and run to score a point, and fast pitch play, which requires players to have physical and physiological strength in the game.

Keywords: Agility, Elite and sub-elite, Flexibility, Physical, Speed

INTRODUCTION

Softball is a sport derived from baseball, played with a large ball and on a small ball. It was initially referred to as indoor baseball, kitten ball, or mush ball before being renamed softball in 1926. George Hancock, a Chicago Board of Trade employee, is credited with inventing softball in 1887 when he tied a boxing glove into a ball shape and used it to play a game with his friends. The first softball game was played on a small field with a ball much larger than a baseball. The game quickly gained popularity, spreading to Chicago, where it was played both indoors and outdoors. Unlike baseball, softball has an underarm pitch because when the sport was first created in the late 19th century, it was intended to be a less physically demanding version of baseball that could be played indoors or on smaller fields. Hence, to achieve this, the pitching style was changed from overhand to underhand. The underhand pitch is less physically demanding than the overhand pitch used in baseball, as it relies more on the pitcher's arm and leg strength than their shoulder and back muscles. This makes it easier for players of all ages and skill levels to participate in the sport without risking injury. The underhand pitch also allows for more accuracy and control, as the pitcher can use their wrist and fingers to finesse the ball's trajectory and speed. This is particularly important in softball, where the smaller field and shorter distances between bases require quick and precise throws (Marcus, 2023).

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Statement of the problem

From the above surface of the literature and background, the researcher was interested in conducting the study, "*Assessment of selected physical performance parameters of elite and sub-elite softball players*."

Purpose of the study

1. To assess selected physical performance parameters of softball players
2. To compare selected physical performance parameters between elite and sub-elite softball players.

Hypothesis of the study

It is hypothesized that there would be a significant difference in physical performance parameters of elite and sub-elite softball players.

MATERIALS AND METHODS

Population

Manipur University All India inter-university level for Elite players and zonal level players for Sub-Elite, under the age range of 18–25 years, is taken in this study.

Selection of subjects

Out of the whole population of softball players, those actively representing the Manipur University All India Inter University level players and zonal level players under the age of 18–25 years are selected as subjects. Altogether 20 (Twenty) players of softball, consisting of 10 players each from both elite and sub-elite softball players, are selected by accomplishing a purposive sample technique.

Significance of the study

1. It may help the instructor to develop a sound training program
2. The study may help to diagnose the need and its relation to body mechanics, fitness, and motor skills
3. The study may help the player to realise their own fitness level.

Criterion measures

The variables had been recorded by the following criterion measures, as shown in Table 1.

Analysis and interpretation of data

The necessary data were computed and analysed using descriptive analysis, such as mean and standard deviation (SD) of the collected data, which was calculated, and the comparison was done by using an independent *t*-test to compare selected physical performance parameters between elite and sub-elite softball players. The statistical significance level was set at $P < 0.05$, and statistical analysis was calculated by Statistical Package for Social Sciences version 20.

Findings of the study

The data collected on (20) male players, 10 each from elite and sub-elite softball players, and the findings of the physical parameters between the players through sit and reach test, Illinois Agility Test and 20-m sprint test.

Table 1:

S. No.	Variables	Methods	Criterion units
1.	Flexibility	Sit and reach test	Centimetre
2.	Agility	Illinois agility test	Second
2.	Speed	20-m sprint	Second

Table 2 shows that the mean and SD values for elite (high performance) softball players on the flexibility variable were 39.90 and 5.95, whereas for sub-elite (low performance) softballers were 35.70 and 5.07, respectively. There is an insignificant difference occurring as the calculated value $t = 1.69$, which is less than the tabulated value = 2.10 at a 0.05 level of confidence for two-tailed tests ($P > 0.05$).

The graphical representation of the mean of flexibility between elite and sub-elite softball players is shown in Figure 1.

Table 3 shows that the mean and SD values with regard to elite (high performance) softball players on the agility variable were 18.60 and 0.57, whereas in the case of sub-elite (low performance) softballers, they were 18.80 and 0.85, respectively. There is no significant difference occurring as the calculated value $t = 0.60$, which is less than the tabulated value = 2.10 at a level of confidence for two-tailed tests ($P > 0.05$).

The graphical representation of the mean of agility between elite and sub-elite softball players is shown in Figure 2.

Table 4 shows that the mean and SD values for elite (high-performance) softball players on the speed variable were 3.25 and 0.13, whereas in the case of sub-elite (low-performance) softballers, they were 3.49 and 0.39, respectively. There is an insignificant difference occurring as the calculated value

Table 2: The significance of the mean comparison of elite and sub-elite softball players (high and low performance) on flexibility

Group	No. of samples	Mean	Standard deviation	*t*-value	Significance (*P*-value)
Elite (High performance)	10	39.90	5.95	**1.69**	0.10
Sub-elite (Low performance)	10	35.70	5.07		

*Significant at 0.05 level of confidence, table value of $t_{0.05\,(18)}$=2.10

Table 3: The significance of the mean comparison of elite and sub-elite softball players (high and low performance) on agility

Group	No. of samples	Mean	Standard deviation	*t*-value	Significance *P*-value
Elite (High performance)	10	18.60	0.57	**0.60**	0.55
Sub-elite (Low performance)	10	18.80	0.85		

*Significant at 0.05 level of confidence, table value of $t_{0.05\,(18)}$=2.10

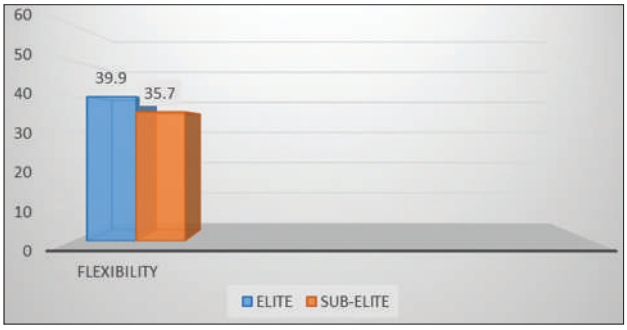

Figure 1: Mean comparison for the flexibility of elite and sub-elite softball players

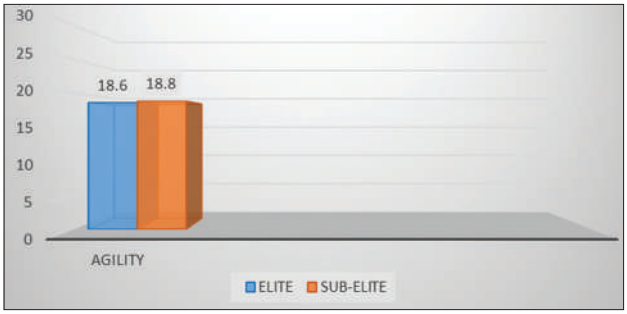

Figure 2: Mean comparison for the agility of elite and sub-elite softball players

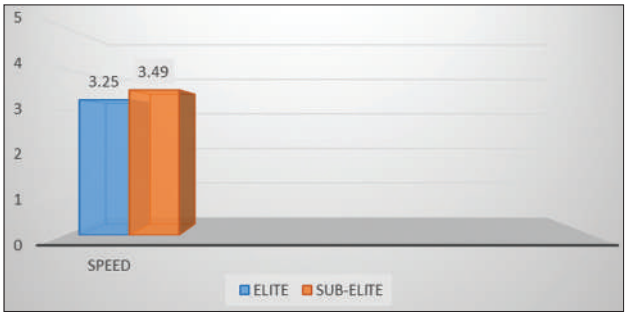

Figure 3: Mean comparison for speed of elite and sub-elite softball players

$t = 1.78$, which is less than the tabulated value = 2.10 at a level of confidence for two-tailed tests ($P > 0.05$).

The graphical representation of the mean speed between elite and sub-elite softball players is shown in Figure 3.

DISCUSSION OF THE FINDINGS

From the above finding of the study, it revealed that there was an insignificant difference between elite and sub-elite softball players, as the calculated value of "*t*" = 1.69, 0.60 and 1.78, respectively, which is less than the critical $t = 2.10$ at a 0.05 level of confidence for two-tailed tests ($P > 0.05$). The reason might be due to games' high demand for physical and physiological efficiency. Flexibility, agility and speed are very important in this game for hitting the ball and running base to base and also in fielding, pitching and catching. The nature of the play, the game depends on hit and run to score a point, and fast pitch play, which requires players to have physical and physiological strength in the game. Thus, an insignificant physical performance parameter in the game. (Ooi *et al*. 2009) reported no significant difference between groups in shuttle run tests and on-court badminton-specific movement agility tests in the physiological characteristics of elite and sub-elite badminton players. Again (Masanovic *et al*., 2019) reported a significant difference was found in variables height, weight, muscle mass, bone content, and body fat, while a significant difference was not found for the remaining variable, body mass index, in the study of anthropometric measurement and body composition between basketball players from different competitive levels: Elite and sub-elite.

Table 4: The significance mean comparison of elite and sub-elite softball players (high and low performance) on speed

Group	No. of samples	Mean	Standard deviation	*t*-value	Significance *P*-value
Elite (High performance)	10	3.25	0.13	**1.78**	0.09
Sub-elite (Low performance)	10	3.49	0.39		

*Significant at 0.05 level of confidence, table value of $t_{0.05\,(18)}$=2.10

CONCLUSION

The research concluded that the elite and sub-elite softball players showed excellence in physical performance parameters. There was no significant difference in the physical performance parameters of elite and sub-elite softball players (flexibility, agility, and speed) in the game. The insignificance may be due to games' high demand for physical and physiological efficiency, fast pitch play and requires players to have physical and physiological strength in the game.

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Research Article

Effect of speed, agility, and quickness drills on reaction time among the Thang-Ta players

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ABSTRACT

Purpose: The Study aimed to determine the effectiveness of Speed, Agility, and Quickness (SAQ) drills on reaction time among the thang-ta players. **Methods:** For this study, a total of 18 thang-ta players (age 15–17 years) were selected from the Career guidance and counselling centre school, Wango, Imphal West, Manipur. A total of two groups in this study: The experimental group (n = 8) and the control group (n = 8). The SAQ training course was conducted over a period of 4 weeks, 5th days of training and 60 min each session to the training group, and for the control group, no special training was administered. The significance value was set at a 0.05 level of confidence, and the paired t-test was applied. **Results:** The Experimental group showed improvement in the Hand and Foot Reaction time compared to the control group ($P < 0.05$). The mean and standard deviation of Hand and Foot Reaction time for pre- and post-test of the Experimental group were 1.13 ± 0.44 and 0.40 ± 0.08, 0.98 ± 0.40 and 0.52 ± 0.17, respectively. The mean and standard deviation of hand and foot reaction time for pre- and post-test of the control group were 1.47 ± 0.27 and 1.17 ± 0.48, 1.11 ± 0.32, and 3.40 ± 0.05, respectively. **Conclusion:** It was found that the SAQ training program group had shown a considerable improvement in reaction time compared to the control group. It was confirmed that a 4-week training program was effective in improving the reaction time among the thang-ta players.

Keywords: Reaction time, SAQ training, Thang-ta players

INTRODUCTION

The Thang-Ta is one such martial art. From war practices during the kings, it has developed into fine martial arts, and it has become a popular sport in Manipur and India. It is now listed as a martial art in the encyclopedia of the martial arts of the world (Green, 2001). Although the origins of Thang (Sword) and Ta (Spear) are merged with Mythology, scientific studies have given evidence of a very early use of iron in Manipur (Sheikh 2017). According to Prof. H. Tombi, Thang-ta is a fundamental art and the foundation of Manipur's invaluable culture, while being mostly considered as a martial art for self-defense. The Indian government recognizes it, and many Thang-ta artists have received Sangeet Akademi Awards (Anonymous 2019). Speed, Agility, and Quickness (SAQ) are among the most crucial and visible elements of athletic performance. The main objective of a proposal is to increase (SAQ), enhance one's ability to respond quickly, apply a lot of force quickly in the correct direction, and redirect it if necessary. A carefully developed program that takes these elements of athletics greatly improves overall performance and reduces injury risk. Learned motor skills are needed for SAQ. Every individual's level of skill will differ; learning the effective and efficient use of these skills can enhance overall athletic ability (Brown *et al*., 2000). The SAQ method of training "involves progressive exercises to develop an athlete's ability to be more skillful at faster speeds and with greater precision." High levels of physical fitness are required for all athletes to meet the demands of the game. Therefore, it is essential that coaches and physical

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education teachers condition their athletes to improve their sport-specific attributes and prepare them for competition in an effective manner with the help of the SAQ training method (Polman *et al*., 2009). A player's performance is affected by several kinds of Physiological, psychological, and physical factors. Reaction time is essential in practically every sport and game. Reaction time in sports performance refers to the capacity to react quickly to a stimulus, such as sound or sight, while maintaining good posture and control. Reaction time is a crucial performance metric that impacts how quickly and efficiently decisions are taken. The reaction time is the interval of time between the starting point of a stimulus and the start of the muscle response (Thomas, 2013).

Objective of the Study

The study is to find out the effect of SAQ drills on Reaction time among the Thang-ta Players.

Statement of the Problem

The purpose of the study was to find out the Effect of SAQ drills on Reaction time among the Thang-ta Players.

Hypothesis of the Study

It was hypothesized that there would be a significant difference in SAQ drills on Hand and Foot Reaction time among the Thang-ta Players.

METHODOLOGY

For this study, 18 male Thang-ta Players (age 15–17 years) were selected from the Career Guidance and Counselling Centre School (CGCC), Wangoi, Imphal West, Manipur. The selected 18 male Thang-ta players were split into the Experimental (n = 9) and control (n = 9) groups at random. All subjects in the Experimental group and Control group were to be tested as a pre-test on the selected variables (Hand and Foot Reaction time). After the pre-test, SAQ drill training was administered for 4 weeks to the experimental group. For the control group, there is no training employed. After a 4-week training program, both groups were administered the test under the same conditions as they were tested during the pre-test stages. The data were collected by administering the tests for the selected variables. The following variables were chosen by the researcher for this investigation. Hand reaction time and Foot reaction time.

Criterion Measure

Hand and Foot reaction time was measured by using a digital visual reaction timer (Takei) and was measured in the quickest milliseconds.

Training Program

The Training program was conducted at CGCC, Wangoi, Imphal West, Manipur. The SAQ training was provided to the subjects of the experimental group. Over the span of 4 weeks, the training sessions took place 5 days a week on Monday, Tuesday, Wednesday, Thursday, and Friday. Every training session was 60 min work out with warm-up exercise for 10 min, 10 min of cooling down, and the main exercise for 40 min. The following drills were used for this study: Speed: "A" Skips, Skipping for height, Straight leg shuffle, Push-up and Sprints, Ladder drill, Resisted knee drive weighted arm swing, Agility: 20 m Shuttle run, 10×4 m Shuttle run, carioca, Ladder Speed runs repeated vertical jumps Quickness: Repeated vertical jump, one-handed tap drills with partner, tap drills. The repetition and sets were gradually raised from the 1st to the 4th week, whereas the load intensity remained at low to medium for the 1st week and gradually increased to moderate to high for the remaining weeks.

Statistical Analysis

For the study on the effect of SAQ drills on Reaction time among the Thang-ta Players, the paired t-test was employed to find the significant difference in Hand and Foot Reaction time between the Experimental and control groups. The significance level was determined at the 0.05 level. The data were calculated through Statistical Package for the Social Sciences, Version 22.

RESULTS AND FINDINGS

Table 1 shows the mean and standard deviation of descriptive analysis for hand reaction time and foot reaction time. Experimental group pre- and post-test of hand reaction time were 1.13 ± 0.44 and 0.40 ± 0.08, where the t value obtained was 5.87, and the P = 0.12. For foot reaction time, 0.98 ± 0.40 and 0.52 ± 0.17, where the t value obtained is 4.82, and the P = 0.011. Control group pre- and post-test mean and standard deviation of hand reaction time 1.47 ± 0.27 and 1.17 ± 0.48, where the t-value obtained is 2.34 and P = 0.082 for foot reaction time 1.11 ± 0.32 and 3.40 ± 0.05, where the t-value obtained is 7.60, and P = 0.204. The P-value for the experimental group hand reaction time and foot reaction time were found to be significant, and P-value for the control group hand reaction time and foot reaction time are not found significant. Thus, from the table, it was found that the SAQ training on Reaction time is effective.

The graphical representation of hand reaction time and foot reaction time was presented in Figure 1.

DISCUSSION AND FINDING

From the above statistical analysis on SAQ drills on reaction time among the Thang – Ta players for both tests shows that the per- and post- test changes for the control group were not

Table 1: Descriptive analysis and paired t-test comparison of the experimental group and the control group

Variable	Group	Mean	Standard deviation	T	Significance
Hand reaction					
Pre	Experimental group	1.13	0.44	5.87	0.012
Post		0.40	0.08		
Foot reaction					
Pre		0.98	0.40	4.82	0.011
Post		0.52	0.17		
Hand reaction					
Pre	Control group	1.47	0.27	2.34	0.082
Post		1.17	0.48		
Foot reaction					
Pre		1.11	0.32	7.60	0.204
Post		3.40	0.05		

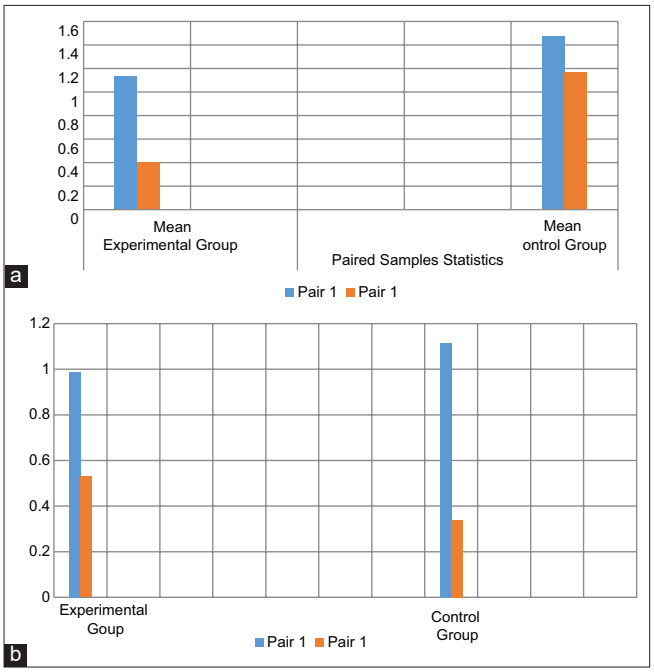

Figure 1: (a) Hand reaction time and (b) Foot reaction time

a significant effect, while the experimental group showed a significant effect after training. In the comparison of both tests between the control group and the experimental group, it was found to be significant between the groups. The study revealed that the SAQ drill of Thang-Ta Training may be more suitable and effective in reaction time for the Thang-Ta players. Ibrahim and Nabia (2017) confirm that male college students can benefit by building muscle strength and improving speed types and reaction time through SAQ exercises. Turna (2020) found in this study that agility training on reaction time in fencing could be positively affected by active reactive agility training applications.

DISCUSSION OF HYPOTHESIS

The study aimed to determine how the SAQ drill affects the Thang-ta players' reaction times. There was a hypothesis that there would be a significant difference in hand and foot reaction time among the thang-ta players. The study's findings showed that there were significant conclusions related to hand and foot reaction time, and the hypothesis was accepted in this study.

CONCLUSION

On the basis of the obtained result, it is concluded that SAQ drill training has improved hand reaction time and foot reaction time among the thang-ta players.

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Research Article

Comparative analysis of aerobic capacity in different playing positions of women soccer players of Manipur

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ABSTRACT

Purpose: The purpose of the study was to compare aerobic capacity among defenders, midfielders, and forwards of national-level women's soccer players from Manipur in different playing positions. **Methods:** A total of 60 national women's soccer players from different clubs of Manipur were divided into three groups, namely defenders ($n = 20$), midfielders ($n = 20$), and forwards ($n = 20$), respectively. Aerobic capacity was measured using a 1500 m run test, with results reported in minutes. To compare the different playing positions of women soccer players, descriptive statistics and analysis of variance were used. **Results:** The researcher found in this study that the aerobic capacity of defenders, midfielders, and forwards had a mean value of 14.72, 14.08, and 14.51, respectively, and there was a significant difference, $P = 0.031^* < 0.05$. In this study, there were significant differences between defenders, midfielders, and forwards. **Conclusion:** The researcher conducted the results of the paper on aerobic capacity in women soccer players in Manipur. There were significant differences among defenders, midfielders, and forwards.

Keywords: Soccer, Defenders, Midfielders, Forwards, and Women

INTRODUCTION

Soccer is also called association football. In this game of football, two teams of eleven players each compete, including one goalkeeper and ten outfield players per team. More goals have to be scored in the match to win the game. Football has an organization, the Federation Internationale de Football Association, established in the 21st century. Most of the people around the world play football over 1.3 billion people in the world, approximately 250 million football players (Rollin *et al*., 2021). The world's most popular football person Pele said, "Football is like a religion to me, I worship the ball and treat it like a God." Football encourages powerful emotions and competitive commitment like no other game on earth (Singh, 2006). Soccer is a team game that requires highly joint relations among all players in different playing positions to be successfully performed to win the match. Soccer needs high physical, physiological, and psychological fitness, tactics, technique, and skill abilities. Aerobic capacity plays a major role in soccer players. The athlete aims to increase the metabolic process and the transformation of chemical energy into mechanical energy (Bowers and Fox, 1988). Aerobic capacity is the metabolic process by which oxygen is used by living beings to produce energy for various activities. Maximal oxygen uptake is the maximum amount of oxygen that is consumed per unit of growing intensity (Flex *et al*., 2000) and (Rankivic *et al*., 2010).

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Different Playing Positions in Soccer

A soccer team is made up of eleven players, which consists of one goalkeeper and ten outfield players. The various playing positions are stated as: In defenders, there are full-backs, known as the left-back and right-back; in midfield, there are left half, center-half, and right-half; and for the forward line, there are outside-left (or left wing), inside-left, center-forward, inside-right, and outside-right (or right wing) (Wallace and Norton, 2014).

Aerobic capacity

Aerobic capacity is defined as the maximum amount of oxygen the body can use during a specified period, usually during intense exercise (Clark, 1995).

Objectives of the Study
To compare the comparative analysis of aerobic capacity in different playing positions of women soccer players of Manipur.

Statement of the Problem
The problem of the study is a comparative analysis of aerobic capacity in different playing positions of women's soccer players of Manipur.

Hypothesis of the Study
The hypotheses of the study are as follows:

H_1: It is hypothesized that there may be no significant differences in aerobic capacity in different playing positions of women soccer players of Manipur.

Selection of the Subjects
For this study, the researcher randomly selected a total of 60 women football players at the national level in different playing positions from Manipur. The age of the selected subjects ranged from 17 to 20 years.

Group	Number
Defenders	20
Mid-fielders	20
Forwards	20
Total	60

Sources of Data
The sources of data were 60 selected women soccer players from Manipur who had represented national-level tournaments. The required data were collected from selected subjects using a standardized test. These selected subjects will be the sources of data for the study.

Criterion Measure
Aerobic capacity was measured using a 1500 m run test, with results reported in minutes.

Data Collection
Data were collected from different clubs of Manipur, namely the Young Youth Club, Langthabal (YWU), KRYPSA, and FC IMPHAL. First, I obtained permission from the club's authority and informed them of the test to be demonstrated in front of the players, then gave a light warm-up, and after that, collected data from the women's national soccer players of Manipur.

Statistical Analysis
To identify the basic features and characteristics of the data, descriptive analysis will be employed. To compare the significance of mean differences among women soccer players in different playing positions on aerobic capacity, the analysis of covariance (analysis of variance) was employed. The level of significance of the study will be set at 0.05, and all statistical techniques will be performed using IBM Statistical Package for the Social Sciences Version 20.

Finding
In Table 1, we can clearly understand the frequency of the groups. There are three groups: the first is defenders, the second is midfielders, and the third is forwards. The frequency of each group is 20 total number of frequencies is 60. National-level women's soccer players in Manipur.

In Table 2, we can clearly see that they are divided into three groups: defenders are 20, midfielders are 20, and forwards are 20 each. The mean value of the defender is 14.72 min, the midfielder is 14.08 min, and the forward is 14.51 min. The standard deviation in these three groups, defender, midfielder, and forward, was 0.766, 0.840, and 0.661. The three groups of the frequency of Table 2 are 3.710, and the *P*-value (Sig) is 0.031*, $P < 0.05$ (0.05 < 0.031*). There was a significant difference between the three groups.

In this figure, the graphical representation of the mean comparison of aerobic capacity of the groups is given in Figure 1.

DISCUSSION AND FINDINGS

Soccer is a difficult game played over a long duration of 90 min. During the play, we used to jump, kick, tackle, and run at high velocity in the match; all the players move everywhere in the field, they use the aerobic energy system at a high intensity of physical activity (Lemmick *et al*., 2004). They perform better during the game to build up their aerobic capacity because soccer and the show are

Table 1: Frequency of the groups

Group	Frequency
Defender	20
Midfielder	20
Forward	20
Total	60

Table 2: Descriptive and ANOVA analysis of aerobic capacity

Group	N	Mean	Standard deviation	F	*P*-value (significant)
Defender	20	14.72	0.762	3.710	0.031*
Midfielder	20	14.08	0.840		
Forward	20	15.51	0.661		

ANOVA: Analysis of variance. *Statically significant when $P<0.05$.

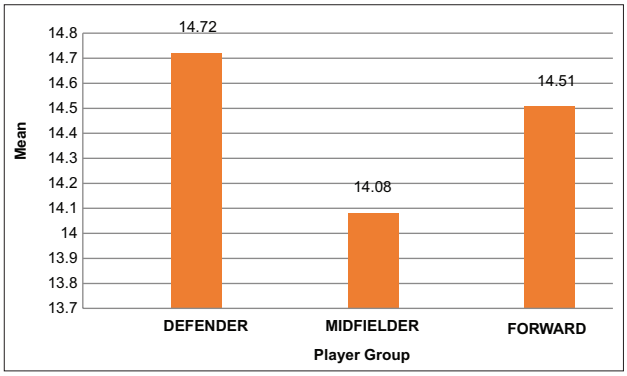

Figure 1: Mean values of the groups in aerobic capacity

essential. Increases in aerobic capacity are necessary to improve work intensity, speed, frequency, distance traveled, and ball timing. It also improves recovery timing (Da Silva *et al*., 2008), (Helgerud *et al*., 2001), (Hoff and Helgerud, 2004), and (McMillan *et al*., 2005). The researcher found in this study the comparative analysis of aerobic capacity in different playing positions of women soccer players of Manipur. In modern football, the players playing as different playing positions have the same training, but as per the different playing positions, the technical, tactical, physical, and physiological demands also differ according to their playing positions.

As per the results of the study, there were significant differences found in aerobic capacity. The mean value of the defender is 14.72 min, the midfielder is 14.08 min, and the forward is 14.51 min. Midfielders perform better than defenders and forwards. Some of the studies to support our study are (Hossein Soltani *et al*., 2012). The study revealed that a significant correlation in aerobic capacity was found between the three groups.

Discussion of Hypothesis

In this study, it was hypothesized that there may be no significant differences in aerobic capacity in different playing positions of women's soccer players of Manipur. The findings of the study revealed that there is a significant difference in the study. Therefore, the hypothesis of the study was rejected in this study.

CONCLUSION

The study was a comparative analysis of aerobic capacity in different playing positions of women's soccer players of Manipur. The study's conclusions showed that three groups of Manipur-based women's soccer players had significantly different aerobic capacities.

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Research Article

The effect of employing a hybrid model combining learning based on play and the constraints-led approach on developing skill performance, strategic decision-making, and motivation to learn among physical education students in volleyball

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ABSTRACT

This research aims to identify the effect of employing a hybrid model combining teaching games for understanding (TGfU) and the Constraints-Led Approach on developing skill performance, strategic decision-making, and motivation to learn among 2nd-year volleyball students at the College of Physical Education and Sports Sciences, University of Babylon, during the 2025–2026 academic years. To achieve the research objectives, the researcher adopted an experimental approach using a two-group pre-test/post-test design with equivalent groups. The research sample consisted of 2nd-year students, who were then divided into two groups: An experimental group that studied using the hybrid model, and a control group that studied using the traditional method. Pre-tests and post-tests were administered to both groups on the variables of skill performance, strategic decision-making, and motivation to learn from February to May 2026 in the sports hall at the University of Babylon. The results showed no statistically significant differences between the two groups in the pre-tests, indicating their equivalence before the experiment. The results also showed statistically significant differences between the pre-test and post-test scores for the experimental group, favoring the post-test, across all research variables. Furthermore, the experimental group outperformed the control group in the post-tests. The researcher concludes that the hybrid model combining TGfU and the restrictive approach was more effective than the traditional method in developing skill performance, improving strategic decision-making, and increasing motivation to learn among 2nd-year volleyball students. The research recommends adopting this model in teaching team sports at faculties of physical education and sports science, and conducting similar studies with other samples and variables.

Keywords: Hybrid model, Learning constraints-led approach, Volleyball

INTRODUCTION

Volleyball is a team sport that demands a complex integration of precise technical skill, rapid tactical understanding, and the ability to make decisions in constantly changing game situations. Therefore, traditional teaching methods based solely on repetition of skills in isolated contexts are no longer sufficient to prepare physical education students for the demands of real-world performance within a match. In this context, alternative teaching models have emerged in modern physical education literature, focusing on learning within the context of play and on building tactical understanding alongside skill development.

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The teaching games for understanding (TGfU) model and the constraints-led approach (CLA) are among the most notable of them. The scientific reviews show that TGfU has emerged as one of the most common models in physical education research because it has facilitated restructuring of learning around game-based problems, motivating students to understand, make decisions, and take active participation in learning.

The TGfU model also changes a learner into an active aspect of analyzing the game situation and understanding its requirements, rather than a passive performer of a skill. This is done by means of mini-games, guiding questions, and development between tactical awareness and choice and action of the correct response. A meta-analysis and systematic review indicated that the tactical interventions related to this method have a significant positive impact on decision-making over

traditional techniques that were technical in nature, and the beneficial results in skill performance were present, although to a lesser extent of reliability. This implies that learning that brings the learning to the practical, real-life tactical situations equips the students to learn that they are supposed to do something, why to do it, and when to do it, as opposed to the students merely learning how to do the movement.[1]

The constraint approach, on the contrary, is based on an approach of environmental dynamics. It is based on the hypothesis that motor learning does not take place by teaching a predetermined motor model, but instead it is through the interaction of the learner with the restrictions of the task, the environment, and the personal attributes. It is this interaction that encourages the learner to self-regulate and find effective solutions that produce the motor solutions that solve the situation. Renshaw *et al*. demonstrated that this approach provides a crucial foundation for integrating motor learning theories with classroom practice in physical education. This is because it allows for the guidance of skill acquisition and decision-making behaviors through the modification of constraints, rather than imposing standardized responses on all learners. Furthermore, recent literature shows that CLA has become a viable pedagogical option in sports and physical education, particularly when creating authentic learning environments that mimic the complexity of real-world performance.[2]

Therefore, employing a hybrid model combining TGfU and CLA appears to have significant scientific and pedagogical value. The former provides a pedagogical framework based on play-based problems and tactical understanding, while the latter offers the theoretical and practical foundation for designing rich learning environments by modifying constraints in a way that stimulates exploration and adaptation. Some theoretical work has suggested the possibility of bridging these two models within an ecological teaching framework, as both share a rejection of rigid, linear instruction and an emphasis on contextual learning, learner-centeredness, and the connection between skill and decision-making within the situation. Therefore, integrating these two approaches could represent a promising avenue for teaching volleyball. Teachers can create modified game situations in terms of space, number of touches, scoring rules, or player roles, guiding students toward discovering tactical solutions and simultaneously improving their skill execution.[3]

This integration is particularly important in volleyball because successful performance depends not on mastering a single skill in isolation, but rather on the ability to quickly choose the appropriate response under time and space constraints, and in response to changing opponent and teammate positions. An example of physical education classes showed that a TGfU-based intervention helped to build the volleyball skills and to increase the pleasure of learning among students, which proves the efficacy of game-based instruction in the given sport. The positive outcome of other papers on hybrid volleyball units, which are built on TGfU plus other pedagogical models, has also been demonstrated on motivational variables, including intrinsic motivation, autonomy support, enjoyment, and competence. This supports the hypothesis that active and deliberate learning conditions promote student engagement and their willingness to learn and engage.

Hence, the role of investigating the effect of integrating a hybrid model of TGfU and a restrictive model with physical education volleyball students in terms of skills performance as a successful motor transfer of the scenario, strategic decision-making as the essence of team playing, and motivation to learn as a psychological state of enduring involvement and the attainment of profound learning is relevant. Such a strategy is also in line with modern trends in physical education instruction that call for the replacement of teaching skills instruction through remote learning, instead of creating realistic learning that combines thinking with doing, comprehension with application, and predicament with delight. Therefore, testing this hybrid model may provide an important scientific and practical addition to building more effective teaching approaches for volleyball education within physical education student preparation institutions.

Research Problem

The research problem lies in the fact that volleyball instruction for physical education students often relies on traditional approaches that emphasize the repetition of skill performance in isolation from the context of the game. However, the nature of the game requires an integration of correct skill execution, strategic decision-making ability, and motivation to learn and participate. Despite increasing research support for both the TGfU model and the constraint approach as effective approaches to play-based learning and situational adaptation, a research gap exists regarding the effectiveness of combining them in a hybrid model within volleyball lessons, and the impact of this integration on improving skill performance, strategic decision-making, and learning motivation among physical education students.

The main research question can be formulated as follows:

What is the impact of employing a hybrid model combining TGfU and the constraint approach on developing skill performance, strategic decision-making, and learning motivation among physical education students in volleyball?

Research Objectives

1. To identify the effect of employing a hybrid model combining game-based learning (TGfU) and a restrictive approach on developing volleyball skills among 2nd-year students at the College of Physical Education and Sports Sciences during the 2025–2026 academic year

2. To identify the effect of employing a hybrid model combining game-based learning (TGfU) and a restrictive approach on developing tactical decision-making skills in volleyball among 2nd-year students at the College of Physical Education and Sports Sciences during the 2025–2026 academic year
3. To identify the effect of employing a hybrid model combining game-based learning (TGfU) and a restrictive approach on developing motivation to learn among 2nd-year students at the College of Physical Education and Sports Sciences during the 2025–2026 academic year.

Research Hypothesis

1. There are statistically significant differences between the pre-test and post-test results for the experimental group in volleyball skills performance, favoring the post-test
2. There are statistically significant differences between the pre-test and post-test results for the experimental group in tactical decision-making in volleyball, favoring the post-test
3. There are statistically significant differences between the pre-test and post-test results for the experimental group in motivation to learn, favoring the post-test.

RESEARCH METHODOLOGY

First: Research Methodology

The researcher adopted the experimental method, as it is suitable for the nature of the research problem and its objectives. This method is considered one of the most effective for revealing the effect of the independent variable on the dependent variables through relative control of conditions and procedures, especially when using a pre-test/post-test design with an experimental group and a control group. The two-group design with pre-test/post-test is a suitable design for studying the effectiveness of educational programs and interventions.

Second: Experimental Design

The researcher used an experimental design with two equivalent groups:[4]

- The experimental group: Learned according to a hybrid model combining learning through play (TGfU) and the CLA
- The control group: Learned according to the standard or traditional method used in teaching volleyball.

Pre-tests were administered to both groups on the research variables. The educational program was then implemented, followed by post-tests for both groups to compare the results of the two measurements and to reveal the effect of the hybrid model on:

- Skill performance in volleyball
- Strategic decision-making
- Motivation to learn.

This design was chosen because methodological literature describes the two-group pre-test/post-test design as suitable for comparing the amount of change within each group and between the two groups after the intervention.

Third: Research Population

The research population consists of 2nd-year students at the College of Physical Education and Sports Sciences, University of Babylon, for the 2025–2026 academic year. They constitute the target group for this study and its objectives.

Fourth: Research Sample

The research sample was selected from 2nd-year students at the College of Physical Education and Sports Sciences, University of Babylon, and then divided into two groups:

- An experimental group
- A control group.

The sample was selected from students regularly attending classes and participating in the volleyball practical course. Students with injuries or significant absences that might hinder regular participation in the educational program or affect test results were excluded.

Fifth: Research Scope

- Benefice: 2025–2026 academic year from February to May
- Spatial Area: the University of Babylon gymnasium
- Students: 2nd-year international students at the College of Physical Education and Sports Sciences.

Sixth: Research Tools and Data Collection Methods[5]

- Arabic and foreign sources and references related to game-based learning, the restrictive approach, and volleyball
- Pre-test data collection forms and post-test data collection forms
- Volleyball-specific skill tests, including
- A coin: 2. equiparted the role of tactical decision making, game situation, sensory soot that and a tool form - Vetta A itself a vella
- Minnesota State University researchers suggest, “Motivational learning scale appropriate for physical education students”
- Implementation aids, including balls, cones, a net, a court, a whistle, and measurement and recording equipment.

Seventh: Research Variables

- Independent variable: the hybrid model of TGfU and the restrictive approach
- Dependent variable: Skill performances in volleyball. Strategic decision-making
- Motivation for learning.

Eighth: Research Procedures

1) Developing the educational program
   - The researcher created an educational program using an amalgamation of the TGfU model and the constraint approach. The learning units include
   - Keystones resource book viewer, guiding questions to develop strategic understanding
   - Employing task, environment, and learner constraints, for example, changing the size of the playing field, number of touches, rules of performance, and location of players
   - Activities that allow students to explore, choose, and adapt to game situations.

The literature supports this approach in that TGfU focuses on learning through play-based problem-solving and decision-making, while the constraint approach requires placing some emphasis on guiding learning through modifying constraints to promote learning and functional adaptation.

2) Pilot study

The researcher conducted a pilot study with a limited number of students outside the main research sample to ensure:[6]

- The clarity of the instructions
- The validity of the instruments and tests
- The adequacy of the time allocated to each test and each learning unit
- The competence of the support team. Identifying potential obstacles during implementation.

3) Pre-tests

Pre-tests are conducted for both the experimental and control groups on the following variables:

- Skill performance
- Planning decision-making
- Motivation to learn.

This is done before implementing the educational program to ensure the equivalence of the two groups and to determine the students' level before intervention.

4) Implementation of the educational program

The program is implemented with the experimental group between February and May 2026 in the sports hall at the University of Babylon, while the control group continues learning according to the usual method.

For further systematic control, the following are considered:

- Standardizing the duration of the learning unit for both groups
- Standardizing the number of learning units
- Standardizing the spatial conditions as much as possible
- Conducting the educational content sequentially from easy to difficult
- Consistentizing the tools used and the measurement procedures.

5) Post-tests

After the program is completed, post-tests are conducted for both groups on the same variables and under the same conditions and procedures as the pre-tests. To compare the results and determine the impact of the educational program.

Ninth: Equivalence between the Two Groups Statistical Methods

The statistical package for the social sciences was used to process the data and extract the results.

RESULTS

Table 2 shows that there were no statistically significant differences between the experimental and control groups in the pre-test variables, indicating that the two groups were equivalent before the implementation of the educational program.

Table 3 indicates statistically significant differences between the pre-test and post-test scores of the experimental group in skill performance, tactical decision-making, and learning motivation, all in favor of the post-test. This confirms the effectiveness of the hybrid model based on TGfU and the CLA.

Table 4 shows that the control group also improved in the post-test; however, the improvement was limited compared with the experimental group, which may be attributed to the regular instructional method.

Table 5 demonstrates statistically significant differences between the experimental and control groups in the post-test for all research variables, in favor of the experimental group. These findings support the research hypotheses and indicate that the hybrid instructional model had a stronger effect than the conventional.

DISCUSSION

The results of Table 2, which assesses the equivalence of the experimental and control groups in the pre-tests, show no statistically significant differences between the two groups in chronological age, skill performance, strategic decision-making, and motivation to learn. This is a significant methodological indicator of the soundness of the experimental design, as the starting point for both groups was similar before the implementation of the educational program. Achieving pre-test equivalence lends greater credibility to the subsequent results, making the differences that appeared in the post-tests largely attributable to the effect of the independent variable, the hybrid model combining game-based learning (TGfU) and

Table 1: Equivalence between the two groups

S	Variable	Experimental group S±C	Control group S±A	Calculated value of (t)	tabulated value (t)	Level of significance	Significance
1	Chronological age (years)	19.42±0.51	19.38±0.49	0.23	2.05	0.05	Non-Sig.
2	Skill performance (grade)	12.36±1.44	12.18±1.39	0.37	2.05	0.05	Non-Sig.
3	Strategic decision-making (grade)	10.74±1.21	10.61±1.17	0.32	2.05	0.05	Non-Sig.
4	Motivation to learn (degree)	66.83±4.26	66.47±4.11	0.26	2.05	0.05	Non-Sig.

Table 2: Equivalence of the experimental and control groups in the pre-tests

Variable	Experimental group mean±SD	Control group mean±SD	t-value	Significance	Interpretation
Age (years)	19.47±0.52	19.40±0.50	0.38	0.707	Not significant
Skill performance (score)	12.41±1.36	12.23±1.41	0.36	0.721	Not significant
Tactical decision-making (score)	10.81±1.14	10.66±1.19	0.35	0.729	Not significant
Learning motivation (score)	67.10±4.02	66.71±4.25	0.26	0.798	Not significant

SD: Standard deviation

Table 3: Differences between the pre-test and post-test of the experimental group

Variable	Pre-test mean±SD	Post-test mean±SD	Mean difference	t-value	Significance	Interpretation
Skill performance (score)	12.41±1.36	18.92±1.11	6.51	12.84	0.000	Significant in favor of post-test
Tactical decision-making (score)	10.81±1.14	16.75±1.08	5.94	11.97	0.000	Significant in favor of post-test
Learning motivation (score)	67.10±4.02	78.63±3.56	11.53	9.88	0.000	Significant in favor of post-test

SD: Standard deviation

Table 4: Differences between the pre-test and post-test of the control group

Variable	Pre-test mean±SD	Post-test mean±SD	Mean difference	t-value	Significance	Interpretation
Skill performance (score)	12.23±1.41	14.36±1.29	2.13	3.21	0.006	Significant in favor of post-test
Tactical decision-making (score)	10.66±1.19	12.04±1.15	1.38	2.74	0.016	Significant in favor of post-test
Learning motivation (score)	66.71±4.25	69.02±4.03	2.31	2.19	0.046	Significant in favor of post-test

SD: Standard deviation

Table 5: Differences between the experimental and control groups in the post-test

Variable	Experimental group mean±SD	Control group mean±SD	Mean difference	t-value	Significance	Interpretation
Skill performance (score)	18.92±1.11	14.36±1.29	4.56	10.14	0.000	Significant in favor of the experimental group
Tactical decision-making (score)	16.75±1.08	12.04±1.15	4.71	11.28	0.000	Significant in favor of the experimental group
Learning motivation (score)	78.63±3.56	69.02±4.03	9.61	6.94	0.000	Significant in favor of experimental group

SD: Standard deviation

the constraint approach, rather than to pre-existing differences among the students. This procedure is consistent with the requirements of a two-group, two-test-equivalent design, which is a suitable design for evaluating the effectiveness of educational and training programs.[7]

Table 3 showed statistically significant differences between the pre-test and post-test scores of the experimental group across all three variables, favoring the post-test. This indicates that students who learned using the hybrid model demonstrated clear improvement in skill performance,

strategic decision-making, and motivation to learn.[8] This result can be explained by the fact that this model did not treat learning as a mere mechanical repetition of skills, but rather structured the learning experience based on real or near-real game situations. These situations require students to observe, understand, decide, and then execute the appropriate motor response. This characteristic represents the core of TGfU, which begins with understanding the game and its strategic challenges before moving on to technical performance. This contributes to building deeper and more functional learning within team sports. A recent systematic review has shown that TGfU is widely used in physical education because it promotes participation and understanding, placing the learner at the center of the educational process.[9]

The improvement in skill performance among the experimental group can be attributed to the fact that the hybrid model allowed students to practice skills in their actual context, rather than practicing them in isolation and detached from the demands of the game. In volleyball, skills such as serving, passing, receiving, and spiking only acquire their true value when linked to the time and place of performance, teammate positioning, opponent behavior, and the tactical objective of the movement.[10] When learning is built upon mini-games, modified tasks, and carefully considered constraints, skill performance becomes more functionally relevant and transferable to real-life game situations. Therefore, the improvement observed in the experimental group's results cannot be understood as purely technical, but rather as an improvement in the quality of performance, since the student was executing the skill in conditions more closely resembling a match.[11] While some meta-analyses have indicated that the impact of tactical interventions is usually more pronounced in decision-making than skill execution, they have also supported a general trend toward improved in-game performance when learners are taught through meaningful game situations.[12]

Regarding the tactical decision-making variable, the experimental group's superiority in this area is a logical and directly consistent result of the theoretical foundation of the model used. TGfU, in essence, emphasizes tactical awareness, requiring students to determine the most appropriate solution to the situation: Where to direct the ball? When to pass? How to utilize the space? In contrast, the restrictive approach shapes learning environments that encourage learners to seek effective solutions by modifying the task rules, the dimensions of the playing field, the number of touches, or the interaction between players. This creates a type of guided exploration-based learning, where students don't receive ready-made decisions but learn to discover them within the context of the situation itself. A meta-analysis concluded that game-based interventions significantly improve decision-making compared to traditional technical approaches, which strongly aligns with the results in Table 3.[13]

Furthermore, the noticeable improvement in learning motivation among the experimental group can be explained by the nature of the learning environment provided by the hybrid model. When students participate in activities that resemble real play, and feel they have a role in discovery, choice, and solution, they become more engaged, enjoy the learning process, and develop a sense of competence. Furthermore, the variety of learning situations, opportunities for interaction, asking questions, and collaborating with peers all reduce monotony and increase engagement in learning. The literature indicates that TGfU-based programs are associated with positive outcomes in motivational aspects, including enjoyment, perceived competence, and meeting basic psychological needs in physical education lessons. A study on a hybrid volleyball unit also demonstrated that this type of instruction can significantly improve motivational outcomes.[14]

Moving to Table 4, we observe that the control group also showed improvement between the pre- and post-tests, although this improvement was less pronounced than that of the experimental group across all variables. This result seems logical; Because continued exposure to lessons and regular practice, even in the traditional manner, often leads to some degree of improvement in performance, knowledge, or motivation, especially among university students who possess a certain level of physical and motor readiness. However, this limited improvement also indicates that the traditional method, despite its benefits, does not achieve the same level of impact as modern approaches based on play, understanding, and adaptation. The traditional method often tends to focus on repeating the correct motor pattern, but it may not give the student enough opportunities for strategic thinking or for discovering diverse solutions under pressure. Hence, it can be said that the results of the control group do not negate the effectiveness of traditional education, but rather confirm its limitations compared to the hybrid model.

Table 5 is the most decisive table in discussing the research results, as it presents the final post-test comparison between the two groups. It showed statistically significant differences in skill performance, strategic decision-making, and motivation to learn, favoring the experimental group. This result represents the strongest evidence for the success of the proposed educational program in achieving the research objectives and hypotheses. Because the comparison here is no longer within the same group, but between two groups that underwent similar conditions and differed only in their teaching methods, this confirms that the greater improvement observed in the experimental group was a natural consequence of employing the hybrid model. This result also supports what previous studies in volleyball and physical education have indicated: That TGfU-based teaching can develop skills and increase enjoyment, and that the restrictive approach represents an

effective pedagogical option for designing functional learning based on adapting to performance demands.[15]

The experimental group's superiority in skill performance specifically suggests that skill in volleyball should not be viewed as an abstract movement, but rather as a functional response to a specific playing situation. When a student learns a skill within a learning environment that resembles the demands of a match, the chances of retaining the learning and transferring it to actual practice increase. The same applies to tactical decision-making; repeated exposure to situations that require reading the game, utilizing space, and estimating the appropriate timing enhances the player's decision-making efficiency. As for motivation to learn, repeated success in performing tasks, a clear sense of the learning purpose, and a feeling of active participation all contribute to making the student more enthusiastic and engaged.

Based on the foregoing, it can be concluded that the discussion of the four tables leads to the general finding that employing a hybrid model combining TGfU and the restrictive approach in volleyball teaching was more effective than the traditional method in developing the three variables under study. This is because this model combined tactical understanding, contextual practice, restrictive modification, and active exploration, creating a learning environment closer to the nature of the game and more capable of integrating thinking with execution, understanding with performance, and enjoyment with learning. Therefore, the research findings not only support its hypotheses but also provide an educational justification for adopting this type of teaching model in faculties of physical education and sports science, particularly in team sports that require a constant integration of skill, decision-making, and motivation.

CONCLUSION

1. The hybrid model combining learning through play (TGfU) and the restrictive approach contributed to a clear improvement in the skill performance of 2nd-year volleyball students in the college of physical education and sports sciences
2. The hybrid model proved effective in developing tactical decision-making skills among the experimental group by linking learning to real-life game situations and encouraging students to choose appropriate solutions during play
3. Adopting the hybrid model increased students' motivation to learn, as it provided a learning environment based on interaction, engagement, and active participation in educational situations
4. The experimental group, which studied using the hybrid model, outperformed the control group, which studied using the traditional method, in post-test results for all three variables, indicating that the hybrid model is more effective than the conventional method of teaching volleyball
5. The integration of TGfU and the restrictive approach demonstrated the ability to achieve synergy between tactical understanding, skill performance, and motivation, making it a suitable teaching approach for team sports in colleges of physical education and sports sciences.

RECOMMENDATIONS

1. Adopt the hybrid model combining learning through play (TGfU) and the constraint-based approach in teaching volleyball to students in faculties of physical education and sports science, given its proven effectiveness in developing skill performance, tactical decision-making, and motivation to learn
2. Train physical education instructors on how to design instructional units based on mini-games, ask guiding questions, and modify task, environment, and learner constraints to improve the quality of learning within team sports lessons
3. Include this approach in teaching methods and practical applications in faculties for physical education and sports science, as it helps to do integration between understanding of tactics and implementation of skills and to boost the student's motivation
4. Conduct follow-up studies on other team sports, at different samples and academic levels and with broader dependent measures related to cognitive achievement, learning retention and self-efficacy to establish the generality of the hybrid model's impact in different educational contexts.

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