

## BIBLIOGRAPHY

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## APPENDIX – I

### INSTITUTIONAL HUMAN ETHICS COMMITTEE



#### *Avinashilingam*

Institute for Home Science and Higher Education for Women  
(Deemed to be university under Category 'A' by MHRD, Estd. u/s 3  
of UGC Act 1956) Re-accredited with 'A<sup>++</sup>' Grade by NAAC.  
Recognised by UGC Under Section 12 B  
Coimbatore- 641043, Tamil Nadu, India

05.01.2023

#### **Chairman**

Dr.SudhaRamalingam  
Director - Research and Innovation  
Professor- Community Medicine,  
PSG Institute of Medical Sciences &  
Research, Coimbatore.

#### **Member Secretary**

Dr.A Thirumani Devi  
Professor  
Department of Food Science and  
Nutrition

#### **Members**

Mr.K. Anilmoli (Legal Expert)  
Dr.SubashiniK.Sripathi  
Dr. A Saraswathy( Medical Officer)  
Ms. D. Kavitha  
Dr. A R SudamaniRamasamy  
Dr. G. Victoria Naomi  
Dr. Judith Justin  
Dr.AnithaSubash  
Dr. K.Sampath Rami

To  
Ms. Eswari, S.  
Department of Physical Education  
Avinashilingam Institute for Home Science and  
Higher Education for Women  
Coimbatore- 641043

DearEswari,

Ref: Your proposal No. IHEC/22-23/PE-01 entitled "Effect of High Intensity Interval Training, Aerobic Training, Concurrent High Intensity Interval Training and Aerobic Training on Selected Physical, Physiological, and Skill Performance Variable among College Men Football Players" submitted for approval of IHEC 19.11.2022.

The Institutional Human ethics Committee of our University hereby grants approval to your research proposal No. IHEC/22-23/PE - 01 entitled "Effect of High Intensity Interval Training, Aerobic Training, Concurrent High Intensity Interval Training and Aerobic Training on Selected Physical, Physiological, and Skill Performance Variable among College Men Football Players". The Approval number for the same is AUW/IHEC/PE-22-23/XPD-01

We wish you all the best in your research endeavours.


Regards

Dr. A Thirumani Devi  
Member Secretary



APPENDIX – II

PERMISSION LETTER

	<b>G.T.N. ARTS COLLEGE</b> (Autonomous)   A Telugu Linguistic Minority Institution     Affiliated to Madurai Kamaraj University - NAAC Accredited with 'B' Grade   G.T.N. Nagar, Karur Road, DINDIGUL - 624 005. Tamil Nadu.	Web : <a href="http://www.gtnartscollege.ac.in">www.gtnartscollege.ac.in</a> Email : <a href="mailto:gtncollege@yahoo.co.in">gtncollege@yahoo.co.in</a> Phone : 0451-2431299, 2432199
Secretary : <b>Lion. Dr. K. RETHINAM, M.JF</b> Principal : <b>Dr. P. BALAGURUSAMY, M.A., M.Phil., M.Ed., PGDCA., Ph.D.,</b>		


Date: 14.11.2022


To

**The Registrar**  
Avinashilingam Institute for Home science and  
Higher education for women  
Coimbatore.

Sub: S.Eswari, Ph.D -Programme Part time Scholar-  
Statistical data Collection in our Campus-  
Permission granted.  
\*\*\*\*\*

Mrs.S.Eswari, Assistant Professor, Department of Physical Education, G.T.N Arts College (Autonomous), Dindigul, who is pursuing her part-time Ph.D programme under the guidance of Dr.T.Shanmugavalli, Associate Professor in Department of Physical Education, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore is permitted to collect the required statistical data collection for her Ph.D work from the players at our college campus.





**PRINCIPAL**  
**(Dr.P.BALAGURUSAMY)**  
**PRINCIPAL**  
**G.T.N.ARTS COLLEGE**  
**(AUTONOMOUS)**  
**DINDIGUL - 624 005.**

APPENDIX – III

TRAINING APPROVAL LETTER



**NILGIRI COLLEGE** Sports Academy  
OF ARTS & SCIENCE (AUTONOMOUS)



Locally Rooted - Globally Connected

**Mr.Santhosh**, B.S.C Electronics, AIFF

D license, Football ball Coach.

Dear S.ESWARI,

The training Programme for the study entitled —EFFECT OF HIGH INTENSITY INTERVAL TRAINING, AEROBIC TRAINING AND CONCURRENT TRAINING ON SELECTED PHYSICAL, PHYSIOLOGICAL AND SKILL PERFORMANCE VARIABLES AMONG COLLEGE FOOTBALL PLAYERS|| is for 12 weeks under my guidance.

I am pleased to inform you that the schedule of training and the application method have been approved. We understand your enthusiasm for enhancing your skills and knowledge in your field, and we are confident that this training program will provide you with the necessary tools to excel in your role.

During the training, you will have the opportunity to learn from industry experts and participate in interactive sessions that will help to develop new techniques and strategies in your area of expertise. The program has been carefully designed to focus on practical skills and provide you with real-world insights.

Thanking you

Sincerely,

A handwritten signature in black ink, appearing to be 'S. Eswari'.

**APPENDIX – IV**  
**STUDENTS CONSENT FORM**

**Student Consent Form:**

I have understood the information provided. I agree to voluntarily participate in this study/training program.

Student's Name: S. Rajkumar

Student's Signature: [Handwritten Signature]

Investigator's Signature: [Handwritten Signature]

**Student Consent Form:**

I have understood the information provided. I agree to voluntarily participate in this study/training program.

Student's Name: S. Duruga Jothi

Student's Signature: [Handwritten Signature]

Investigator's Signature: [Handwritten Signature]



**Avinashilingam Institute for HomeScience and Higher Education for Women**

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**Appendix L2**

**(Item No 5 of  
Check List) Details of Research  
Publications**

S.No	Article	Journal	Other Details Vol/No/Page No/ Year	Published in UGC- CARE / Scopus Indexed/ Web of Science
1	Optimizing SA@ Performance in Football Athletes Exploring the Influence of High Intensity Interval Training	Fizjoterapia Polska (Polish Journal of Physiotherapy)	NR 5/2024	Scopus Indexed
2	Impact of High- Intensity Interval Training on Specific Physical Factors among College Male Football players	Questiones De Fisioterapia (Journal Physical Theraphy)	Paper Accepted	Scopus Indexed .

\*Proof of list of Journals from Internet to be attached along with copies of reprints.

Scholar

: *P. Emani*  
17/02/2025

Supervisor

: *T. Sivali*  
17/2/2025

*P. S. Srinivasan*

Checked By:

17/2/25

HOD, Dean of Respective School

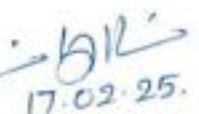
*S. Srinivasan*  
18/2/25

P. S. Srinivasan

The scholar Miss. Eswari, S (APHPEPO05) has published her article and got acceptance from the following journals:

1. Fizjoterapia Polska - indexed and active in Scopus from 2014 to present.
2. She got acceptance from "Cuestiones de Fisioterapia" - is indexed and active in Scopus from 2019 to present.

This may be considered.

J. J.   
17.02.25.  
Asst. Librarian.

# fizjoterapia polska

POLISH JOURNAL OF PHYSIOTHERAPY

OFICJALNE PISMO POLSKIEGO TOWARZYSTWA FIZJOTERAPII

THE OFFICIAL JOURNAL OF THE POLISH SOCIETY OF PHYSIOTHERAPY

NR 5/2024 (24) DWUMIESIĘCZNIK ISSN 1642-0136



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# Optimizing SAQ performance in football athletes exploring the influence of high-intensity interval training

*Optymalizacja wydajności SAQ u piłkarzy: analiza wpływu treningu interwałowego o wysokiej intensywności*

S. Eswari<sup>(A,B,C,D,E,F)</sup>, T. Shanmugavalli<sup>(A,C,D,E,F)</sup>

Department of Physical Education, School of Education, Avinashilingam Institute for home science and Higher Education for Women, Coimbatore, India

## Abstract

**Objectives.** The major goal of this study was to investigate the impact of a twelve-week high-intensity interval training (HIIT) on male football players' speed, agility, and quickness (SAQ) capabilities. Also, this study is to clarify the physiological and biomechanical mechanisms affected by HIIT. This work suggests the sustainability of this HIIT plan over a long period of time.

**Method.** A total of thirty male college football players were split into two groups. One group underwent High-Intensity Interval Training (HIIT) and another group continued with their regular activities. This study was carried out for 12 weeks without changing the usual habits of the participants. The Illinois Agility Test, the Ruler Drop Test, and the Flying 30-meter Test were conducted both before and after the testing time. The T-tests were employed for statistical analysis by comparing both groups.

**Result.** It was discovered that there were no significant gains in quickness ( $p > 0.05$ ), agility ( $p > 0.05$ ), or speed ( $p > 0.05$ ) by comparing the control group to the experimental group. The results of the t-test did not indicate any significant difference between the experimental and control group ( $p > 0.05$ ).

**Conclusion.** The research shows the effectiveness of HIIT program for the improvement of Speed, Agility, and Quickness (SAQ) of male football players. While the current study did not find significant improvements in SAQ, further research is needed to explore the potential benefits of HIIT for football players. Factors such as sample size, study duration and individual differences might have influenced the results.

## Key words

high intensity interval training, speed, agility, quickness, football players

## Streszczenie

**Cele.** Głównym celem tego badania było zbadanie wpływu dwunastotygodniowego treningu interwałowego o wysokiej intensywności (HIIT) na zdolności szybkości, zwinności i reakcji (Speed, Agility, Quickness – SAQ) u piłkarzy. Ponadto badanie miało na celu wyjaśnienie mechanizmów fizjologicznych i biomechanicznych wpływających na efekty HIIT. Praca sugeruje również możliwość długoterminowego stosowania tego planu treningowego HIIT.

**Metoda.** W badaniu wzięło udział trzydziestu mężczyzn, studentów-piłkarzy, podzielonych na dwie grupy. Jedna grupa realizowała trening interwałowy o wysokiej intensywności (HIIT), a druga kontynuowała swoje regularne aktywności. Badanie trwało 12 tygodni, przy czym nawyki uczestników nie ulegały zmianie. Przed i po okresie badania przeprowadzono Test Zwinności Illinois, Test Reakcji z Linijką oraz Test Latający na dystansie 30 metrów. Do analizy statystycznej zastosowano testy T w celu porównania obu grup.

**Wyniki.** Nie stwierdzono istotnych statystycznie przyrostów w zakresie szybkości reakcji ( $p > 0,05$ ), zwinności ( $p > 0,05$ ) ani szybkości ( $p > 0,05$ ) przy porównaniu grupy kontrolnej z grupą eksperymentalną. Wyniki testu T nie wykazały znaczących różnic między grupą eksperymentalną a kontrolną ( $p > 0,05$ ).

**Wnioski.** Badanie wskazuje na potencjalną skuteczność programu HIIT w poprawie zdolności SAQ u mężczyzn-piłkarzy. Mimo że w obecnym badaniu nie odnotowano istotnych ulepszeń w zakresie SAQ, konieczne są dalsze badania w celu zbadania potencjalnych korzyści płynących z HIIT dla piłkarzy. Na wyniki mogły wpłynąć takie czynniki jak wielkość próby, czas trwania badania oraz różnice indywidualne.

## Słowa kluczowe

trening interwałowy o wysokiej intensywności, szybkość, zwinność, szybkość reakcji, piłkarze

## Introduction

Agility is an important feature of football performance, particularly when players want to change the direction of the movement immediately. Wingers are using this technique correctly to create a winning chance by quickly dodging the opponents. The players can enhance their ball retention and outplay opponents by carefully managing their body language. Football demands that players should have many footwork techniques at varying speeds and angles. Such techniques can confuse the opponents and support the team with this flexibility. Young et al. (2021) recommend the deceptive drills in training sessions to enhance agility [1]. These drills can help attackers to make quick decisions in such situations. Speed and agility are most important for success in a any sports situations. Athletes with these skills naturally perform better than their peers in any sports.

Regular exercise produces a variety of physiological adaptations that, regardless of age, gender, or the presence of chronic conditions, give advantages for exercise capacity and health. A growing body of research indicates that a key obstacle to exercising and the global cause of physical inactivity is a lack of time. Due to this problem, models of interval training have gained popularity. These models have been shown to produce adaptations that are comparable to or greater than those of continuous, moderate-intensity training, while also requiring fewer total exercise sessions [2]. Gonzalo-Skok et al. (2023) have emphasized the role of HIIT in functional training, particularly in improving joint stability and reducing the likelihood of sports injuries. The high intensity training positively impacts athletes' physical abilities and specific performance in sports such as aerobic gymnastics, volleyball, taekwondo, judoka, sambo, and wrestling [3].

The young college players must improve the strength of the lower body to be faster and more agile, particularly in football. França et al. (2022) studied the the performance improvement of the players by implementing a comprehensive strategy of strength training along with healthy diet [4]. Core strength is another important factor in this performance improvement strategy. Doganay et al. (2020) found that the 8 weeks of core training program improved quickness and agility among U19 male football players [5]. But it had a small improvement in the speed of the football players. This research highlighted the importance of incorporating core exercises into a comprehensive training program. Furthermore, Andrasic et al., (2021) studied the influence of age on factors of speed and agility in the young football players. Their research indicated that the participants with intense training had more agility compared to participants with regular exercises [6]. Also, Andrasic et al., (2021) highlighted that the elder players performed lesser than the young players in sprint, agility and quickness test [6]. This study highlights the importance of developing a training plan for each age group to improve their performance. The present study provides a optimized solution for addressing these challenges to increase the effectiveness of training program.

The time duration and intensity are the important of other factors in preparing HIIT program for football players. Ho-

strup and Bangsbo (2023) highlighted that the football players can improve their performance by increasing the difficulty level of workouts in the training program [7]. The difficult workouts improve the speed and breathing ability of the football players. Also, It is important to avoid overtraining in the program as intense exercise can reduce the performance of the player. We need to ensure the balance between workout time, intensity, and recovery time to attain better performance. Hostrup and Bangsbo, 2023 provided the valuable guidelines for maximizing HIIT performance in professional football players [7]. The most significant benefits can be achieved only by varying exercise intensity throughout the training phases. Additionally, the sprints and intense cardiovascular exercises can be included in the training program to get better result. Hence, A cautious approach is essential to prevent the detrimental effects of overtraining. Though The balance between recovery and hard exercise is multifaceted, it is essential to attain the equilibrium for better athletic performance. The players can improve their performance level without becoming exhausted or injured if we use the optimized balance between them [7].

A comprehensive football training program must include both aerobic and speed endurance workouts. As these kinds of sports are aggressive and stop-and-go in nature, the program with aerobic and endurance training will assist the players to perform well in the ground. Iaia et al., (2009) highlighted the importance of tailoring these exercises into the training program of each player on basis of their field position [8]. Because, different players may require different amounts of endurance and speed in the game. S. Eswari and T. Shanmugavalli (2023) revealed that the cardiovascular exercise in high-intensity interval training (HIIT) benefits the college football players [8]. The study demonstrated the reductions of blood pressure in both systolic and diastolic system, and thus lead to the lower heart rates. These findings suggest that HIIT can improve overall heart health and athletic performance. These positive outcomes were consistent across all player positions, highlighting the versatility of HIIT as a training method for football players.

HIIT has shown potential in enhancing joint stability and strengthening the deep muscles, which are critical in injury prevention for football players. This makes it an effective tool not only for improving performance but also for integrating into rehabilitation programs, particularly for recovering from ligament and muscle injuries commonly seen in football. Agility and quickness are leading factor for football players to outmaneuver opponents and capitalize the scoring opportunities. In spite of widespread acknowledgment of their importance, it is a challenging work for improving the agility and quickness in both coaches and athletes. Even though HIIT has demonstrated the effectiveness in improving cardiovascular and muscular fitness across various sports, it requires further investigation to make specific impact on speed and agility in football game. The researchers can empower the coaches and athletes to create an effective training regimens for their performance improvement by understanding the physiological characteristics of HIIT.

## Methods

### Participation

Thirty male college football players were randomly selected for the study. They were divided into two groups: an experimental group (n = 15) and a control group (n = 15). The experimental group participated in a twelve-week high-intensity interval training (HIIT) regimen. The control group continued with their routine instruction without HIIT. We obtained ethical approval from the Clinical Research Ethics Committee for this study to ensure the fair and safe practices. Our research protocol adhered to the ethical guidelines outlined in the Declaration of Helsinki. All participants were informed about the study and had signed a written consent for it. To minimize participant anxiety and pressure that might lead to altered behavior, participants were assured of the complete confidentiality of their data. This includes measures to protect their personal information and ensure that their data would only be used for research. The study was conducted along with their competitive season to minimize disruption to their regular training and diet.

### Limitations of the study

It is important to consider the limitations of this research study. The study only included a limited sample size of 30 male football players. It is important to note that these findings may not be generalizable to all football players. Because, the performance outcome depends on various factors including gender, age, and playing position. Also, the study exclusively focused on male participants is another drawback. It is impossible to know for sure if female players will have the same challenges as male players in the football game. Hence, this necessitates the additional studies to understand the impact of HIIT on the agility and speed of female football players. Furthermore, the 12-week trial period may not have been sufficient time to observe all of the long-term benefits of HIIT program. A longer duration of the research is necessary to determine the sustainable improvements in performance and physiological adaptations from this HIIT. Furthermore, the study did not control dietary intake of the participants. Since the diet practice can have a significant impact on their overall performance in sports. Future research should investigate the relationship between diet and exercise by examining the dietary habits of athletes to understand their combined impact on agility and speed. Finally, the controlled laboratory setting of this study diverges from the dynamic and complex environment of actual football matches. Therefore, we should cautiously implement these findings into a real-world training session. We can better understand the implications of this study and instruct the future research directions by recognizing these limitations.

### Delimitations of the study

There are certain limitations in our research study because it was purposefully restricted to examine specific aspects of our research participants. One drawback is that our research was limited to male football players. Therefore, we cannot generalize our findings to other athletes, including female players. It is possible that female players might have responded differently

and achieve different performance outcomes for this HIIT program. The present study exclusively focused on high-intensity interval training (HIIT) to evaluate the impact on speed and agility, without considering the other potential training modalities. The various training methods might have been utilized to increase our understanding the training program for speed, agility and quickness. The twelve-week study duration limits our ability to evaluate the long-term consequences of the HIIT intervention. The research with extended time duration is required to understand the long-term effects. Despite conducting training sessions in a controlled laboratory environment, we were not able to monitor activities outside of the study setting. We cannot generalize the result from this present study as this study lacks the real-world playing condition. These limitations help to direct the future research plan and implement the research findings in the sports.

### Objectives of the study

This study aims to investigate the effectiveness of high-intensity interval training (HIIT) on speed, agility and quickness for football players. Our research examines the basic physiological and physical improvements of football players by HIIT program (fig. 1). These characteristics include energy metabolism, muscle fiber composition and neuromuscular function. We identify the optimized methodology for the implementation of this HIIT program for football players. Helen et al., (2023) emphasized the impact of high intensity interval training program in athletes. The research finding of Helen et al., (2023) has been used as a foundation for our current research work to analysis HIIT program for football players [10].

This present study shows the implementation of HIIT for football players to improve their speed and agility. But we need to understand more to implement the HIIT program in real environment. A complete HIIT program should consider the unique qualities of individual players and their training objectives. The program has to include various kinds of exercises to improve the anaerobic and aerobic abilities of players. These workouts are sprint, movement drills and jumping exercises to improve the quickness characteristic of the player.

This study emphasis the customized HIIT (High-Intensity Interval Training) program to get better results. for players. These customized training plans must consider the current fitness level, injury history and individual objective to improve the efficiency of the program. The certified fitness coaches may be helpful in preparing the customized training program for each player separately. These experts have wide knowledge to prepare a customized plan based on the individual characteristics. We need to consider another important factor, i.e. recovery time, for the improvement of speed and agility of the players. The High-Intensity Interval Training (HIIT) program demands the balance between intense workouts and enough time for recovery. Because, the overtraining will injure the players and decrease the overall performance. Hence, this study aims to balance between workouts and recovery time to attain maximum outcomes. Although players are different from one another, this study results will provide valuable information to prepare an optimized training plan. Football player should work with experts to prepare a customized HIIT program for



the improvement of speed, agility and quickness. The players may improve these abilities without straining their body by utilizing this HIIT program. Even though the HIIT gives a positive result in experimental groups, we need to be cautious in

implementing this in a real environment. Hence, it is important to collaborate with qualified coach to prepare a customized training plan. As every player is unique, all the players need a customized strategy to perform well in the sports.



Figure 1. Conceptual model outlining key considerations of high-intensity interval training (HIIT) programs [11]

### Testing Procedure

Table 1. Standard measurement of test items of the study

S.No	Test Items	Unit of Measurement
1	Flying 30 metre Test	In Seconds
2	Illinois agility test	In Seconds
3	Ruler Drop test	In Seconds

We evaluated the impact of proposed HIIT program on speed and agility of the players by using standard tests. The test was carried out on both experimental and controlled groups. A set of standardized tests was used to analyse the improvement of speed, agility and quickness (SAQ) of the selected football players. The Flying 30-meter Test was used on both groups to measure the linear speed. This ability is very important criteria for in-game acceleration techniques. This performance was calculated by measuring time taken to complete the 30-meter distance straight. Also, the Illinois Agility Test (as shown in fig.2) was employed to measure the quickness

performance of the players. The player had to run as fast as possible through fixed cone obstacles. This obstacle avoidance skill will measure the agility of the players. The Ruler Drop Test was conducted to evaluate their quickness and response time. The reaction time will be measured by calculating the time required to grab a dropped ruler. These three tests allowed us to evaluate the speed, agility and quickness (SAQ) of the players all together. These tests were selected because of their proven applicability in sports activity. This comprehensive evaluation techniques help us to understand the impact of HIIT program on the performance of the players.

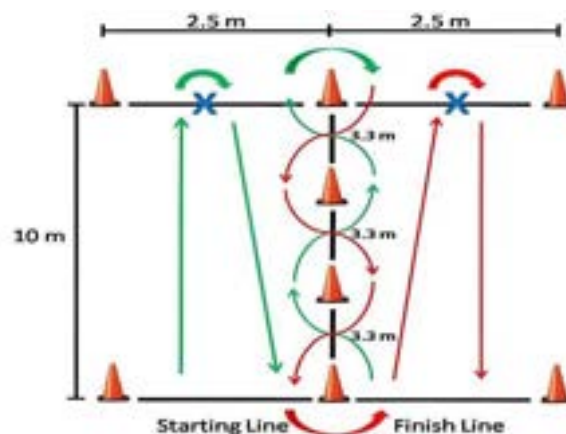


Figure 2. Illinois Agility Test [12]

**Training Schedule**

The experimental group was subjected to a 12 week High-Intensity Interval Training (HIIT) program to improve their speed, agility and quickness. This HIIT program included a number of powerful workouts like sprint, jumping, agility drills and speed ladder. The HIIT training program consisted of 3 sessions per week, each lasting 30-45 minutes including warm-up and cool down. The program focused on improving speed, agility and power through a combination of sprint intervals, agility drills and plyometric training. The intensity of the exercises gradually increased over the 12 week program. Sprint intervals were conducted at 85%, 90% and 95% of maximum heart rate or perceived exertion. Agility drills were

performed at a moderate intensity, while plyometric training was conducted at a high intensity for weeks 4 and 12, and a moderate to high intensity for week 8. Resistance training was incorporated in week 8 at 75-80% of maximum strength. Each workout training session was gradually increased in number of counts and repetitions based on physiological adaptation skill. This kind of progressive training plan increased the adaptability of the players for hard workouts. The recovery time was given to player to avoid fatigue and overtraining. Schoenfeld et al., (2015) emphasized the balance between intense training and recovery time for better results [13]. The table provides the details of exercise routine, encompassing set, repetition and intensity parameters.

**Table 2. The details of exercise routine, repetition and intensity parameters**

Week	Day	Workout Exercise	Volume (Sets x Reps)	Intensity (% of Max)
4	Mon	Sprint Intervals	6 x 40 m	85%
	Wed	Agility Drills	4 x 5 (each drill)	Moderate
	Fri	Plyometric Training	3 x 10 (each exercise)	High
8	Mon	Sprint Intervals	6 x 50 m	90%
	Wed	Speed Ladder Drills	4 x 5 (each drill)	Moderate
	Fri	Resistance Training	4 x 8 (each exercise)	75-80%
12	Mon	Sprint Intervals	6 x 60 m	95%
	Wed	Agility Cone Drills	4 x 5 (each drill)	High
	Fri	Plyometric Circuit	3 x 12 (each exercise)	Moderate to High

An essential component of HIIT is balancing intense training with adequate recovery. Overtraining can lead to performance decline and increased injury risk. It is crucial to implement a structured recovery period within HIIT regimens to maximize the benefits while avoiding exhaustion. The HIIT protocol consisted of three sessions per week, each lasting 45 minutes, incorporating exercises like sprint intervals, speed ladder drills, and plyometric circuits. Intensity was progressively increased from 85% to 95% of maximum heart rate. Each session began with a 10-minute warm-up and ended with a 10-minute cool-down.

**Data collection**

We employed pre-test and post-test data collection methodology to evaluate the impact of HIIT intervention on speed and agility performance training. All the participants were subjected to baseline assessment of their speed, agility and quickness before beginning the training program. These baseline scores of each player served as a benchmark to compare with post-test score to understand the performance improvement if any. The same testing protocol was used for both pre-test and post-test measurement techniques. The post-

test assessment was done after the completion of 12 week HIIT program. Thus, the efficiency of the HIIT program for the improvement of speed, agility and quickness of the players by comparing the pre-test and post-test scores. This data collection method is a straightforward evaluation method for this HIIT program.

**Pre-Test Data Collection**

The baseline assessment scores were calculated for each participant before starting the training program. The speed, agility and quickness of the participants were measured by using Flying 30-meter Test, Illinois Agility Test and Ruler Drop Test, respectively. These tests provide the clear baseline scores for their initial ability in all three factors. The ability of speed, agility and quickness could be tracked through this baseline assessment method during the HIIT program. This allows us to understand their performance during training program and modify the training the program according to the performance of the participants. Additionally, this baseline data set is important to analyze the efficiency of the HIIT program on athletic performance.

### Training Program Implementation

The football players in the experimental group were given the 12 week HIIT program after initial baseline assessment. The aim of this study is to improve the speed, agility and quickness of the football players through HIIT program. The program included the resistance training, plyometrics, agility training and sprint. These exercises were selected because they support the skills required in football. Baz-Valle et al., (2021) suggested a customized training program for highest level of performance in each player [14]. Our proposed HIIT program could maintain the same level of difficulty by gradually increasing the amount of severity of the workouts. The training plan includes quick and powerful exercises to make the muscles more responsive. Schoenfeld et al., (2017) highlighted these powerful exercises can improve the muscular coordination and power [15]. Our goal was to completely improve the speed, agility, and quickness of football players by integrating various training techniques. This strategy addressed every important component to improve their overall performance.

### Post-test Data Collection

The participants from both the experimental and control groups were tested on their speed, agility, and quickness after a 12-week period. The same tests were carried out at the same location and same environment to measure the scores for speed, agility and quickness. The post-test data would be compared with their respective pre-test score to understand the improvement in each ability. The post-test date provided a comprehensive evaluation report of each player. The main objective of this data collection is to find the performance improvement difference between the experimental and control group.

### Data Analysis

We conducted the statistical analysis method on pre-test and post-test data to understand the efficiency of the HIIT program on speed, agility and quickness. We compared their respective ability scores to find the changes in their performance improvement. Also, we compared the assessment data between experimental and controlled groups to find the impact of HIIT program on their performance. The paired and independent t-tests were used to observe the performance changes of the players. This evaluation method explicitly revealed that the performance improvement was only due to HIIT intervention. We were able to understand the impact of the HIIT program on speed, agility and quickness of the players through this data analysis method.

### Statistical Analysis

The statistical analysis method was carried out by comparing the Pre-test and Post-test data of the participants. This method statistically evaluates the efficiency of the proposed HIIT program on football players. The participants were divided into two groups for this statistical analysis. The participants in the experimental group were given the 12-week HIIT program, and the participants in the control group were given their regular exercises without any additional training. The paired sample t-tests were used to evaluate the impact of the HIIT program. And then, we used independent t-tests to examine the differences in players of experimental and controlled groups. This evaluation method used to confirm the performance improvement is only due to HIIT intervention. This study results were not the outcome of coincidence but from statistical analysis method.

**Table 3. Computation of “T” Ratio on Saq of Football Male Players on Experimental Group and Control Group**

Group	Variables	Mean	N	Std. Deviation	Std. Error Mean	T ratio
Experimental Group	Speed	5.29	15	0.53	0.017	7.84*
		5.15	15	0.51		
	Agility	17.71	15	0.81	0.191	13.37*
		17.06	15	0.79		
	Quickness	0.23	15	0.02	0.038	10.34*
		0.13	15	0.02		
Control Group	Speed	5.28	15	0.47	0.003	0.41
		5.28	15	0.48		
	Agility	17.56	15	0.78	0.004	0.15
		17.56	15	0.77		
	Quickness	0.24	15	0.01	0.002	1.38
		0.23	15	0.01		

\*Significant at 0.05, level of confidence

We calculated the initial baseline measurements for speed, agility and quickness. So that, we could compare the pre-test and post-test date to understand the impact of HIIT program. We investigated the sample means, standard deviations, and standard errors of the means to evaluate the closeness to real scores. We performed this calculation for all the components of speed, agility and quickness. We conducted paired sample

t-tests by comparing pre- and post-program scores to find the changes within each group. We compared the two groups using independent samples t-tests to evaluate the impact of HIIT program on the performance of players. We used a p-value of less than 0.05 to indicate statistical significance. This gave us the opportunity to evaluate the efficiency of the HIIT training program. Table 3 provides all of the performance data

that we collected. Its arrangement makes it straightforward to see the results of our statistical analyses. The table shows the averages and percentage changes in scores for the control group (who did not perform the HIIT program) and the

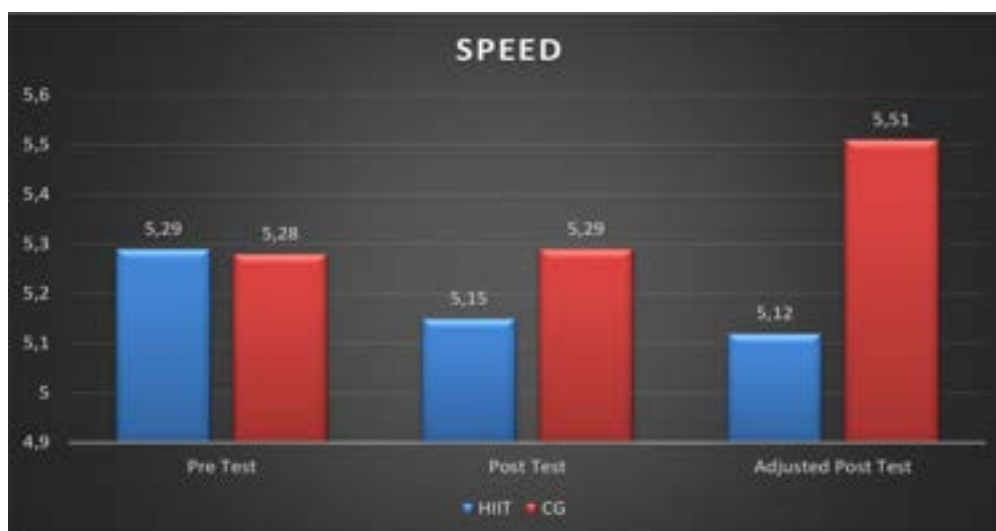
experimental group (who completed the HIIT program). It also determines the statistical significance of the changes, indicating the true impact of the program on athlete performance.

**Table 4. Analysis of covariance of speed, agility, and quickness of investigation teams and control team**

Variables		HIIT	CG	Sum of Variance	Sum of Square DF	Mean Square 'F' ratio		
Speed	Before Test	5.29	5.28	B / S	0.064	1	0.064	0.71
				W / S	2.553	28	0.091	
	After Test	5.15	5.29	B / S	1.550	1	1.550	14.16*
				W / S	3.065	28	0.109	
	Adjusted Post Test	5.12	5.51	B / S	1.105	1	1.105	16.87*
				W / S	1.768	27	0.065	
Agility	Before Test	17.71	17.56	B / S	0.170	1	0.170	0.26
				W / S	17.934	28	0.641	
	After Test	17.06	17.57	B / S	2.670	1	2.670	4.13*
				W / S	18.116	28	0.647	
	Adjusted Post Test	16.89	17.64	B / S	4.196	1	4.196	16.13*
				W / S	0.578	27	0.021	
Quickness	Before Test	0.23	0.24	B / S	0.001	1	0.001	0.006
				W / S	0.015	28	0.001	
	After Test	0.13	0.23	B / S	0.018	1	0.18	37.53*
				W / S	0.013	28	0.000	
	Adjusted Post Test	0.18	0.24	B / S	0.018	1	0.018	48.67*
				W / S	0.006	27	0.006	

A one-way ANOVA was used to evaluate the mean differences in speed, agility, and quickness between the experimental and control groups to further analyze the changes in performance. Table 4 provides the analysis of covariance of speed, agility, and quickness of investigation

teams and control team. Additionally, correlations between variables like training intensity and SAQ gains were examined using Pearson's correlation coefficient. The relative performance of the participants is depicted in the figure 3a, 3b and 3c.



**Figure 3a. Speed performance of the players**

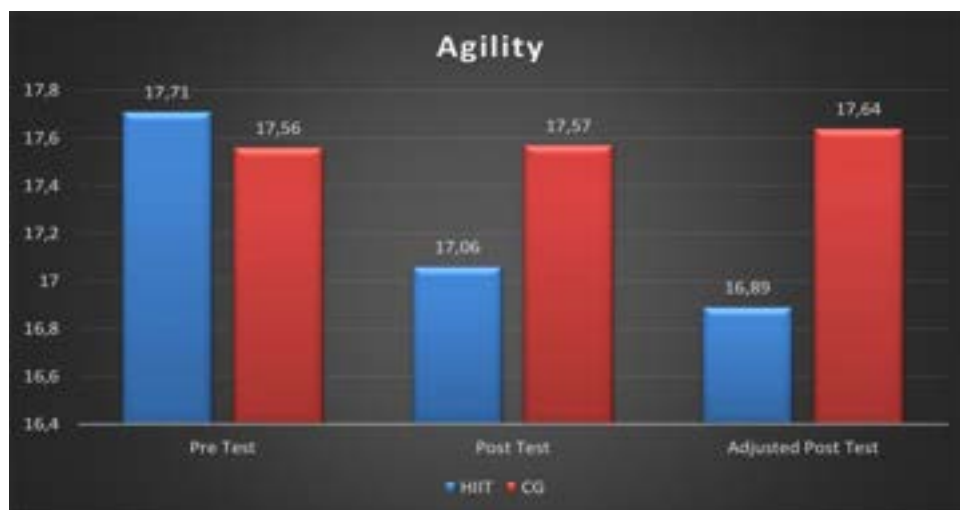


Figure 3b. Agility performance of the players

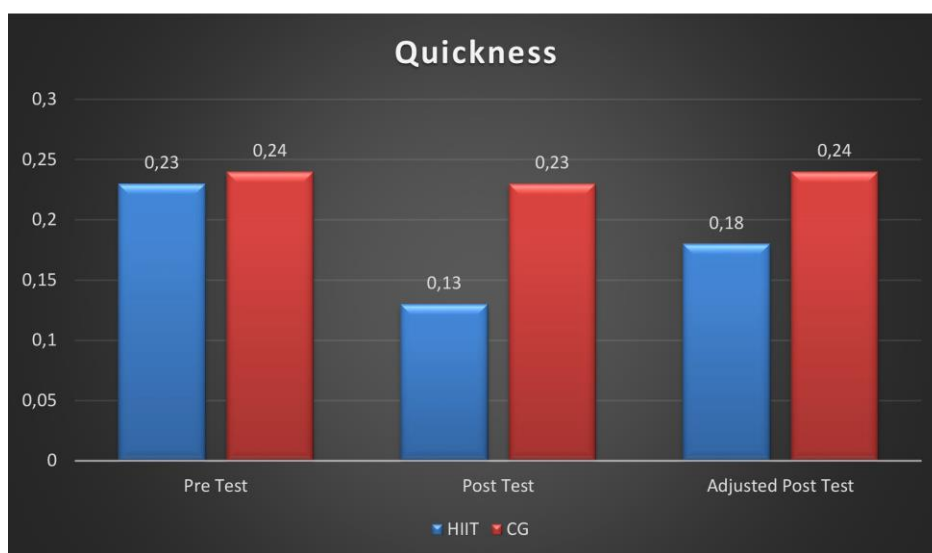


Figure 3c. Quickness performance of the players

### Experimental Group

The proposed 12-week High-Intensity Interval Training (HIIT) program significantly improved the speed, agility, and quickness of the experimental group. The average time for participants to finish the Flying 30-meter Test was 5.29 seconds, with a standard deviation of 0.53 seconds. This is a significant improvement compared to the control group. The findings are statistically significant ( $p < 0.05$ ) and have implications on the efficiency of HIIT program in improving speed. A statistical test called a t-test revealed that this difference was significant. And thus, it confirms the successful implementation of HIIT program in improving the speed. The HIIT engaged group did rather well on the Illinois Agility Test by averaging 17.71 seconds with a standard deviation of 0.81 seconds. The t-test results ( $p < 0.05$ ) showed that this was a statistically improvement compared to the performance of the control group. The Ruler Drop Test revealed that the experimental group had also greatly improved in speed with an average reaction time of 0.23 seconds and a standard variation of 0.02 seconds. This was considerably more

effective than the control group, according to the t-test results ( $p < 0.05$ ). The group who consistently conducted the HIIT workouts performed better than the other group in terms of speed, agility, and quickness. This demonstrates that HIIT can effectively improve these skills in football players.

**Control Group** The control group, who continued their regular training program, exhibited no big improvements in speed, agility, or quickness when compared to the HIIT group. They completed a speed test, and their average time was 5.28 seconds, with minor fluctuations. The scientific analysis of the data revealed that the new high-intensity interval training routine was the reason behind the improvement of speed in another group. The average time for agility would measure the ability to move and change the direction in a game. The controlled group showed almost constant average time for agility, i.e. 17.56 seconds. The participants in the controlled group did not improve their agility skill through their regular exercise. The average quickness value of the control group was 0.24 seconds. This showed a minimum improvement in their quickness ability. The statistical results suggest the HIIT

intervention was the reason behind the performance improvement in the experimental group. So, we proposed the HIIT program as an effective method to improve speed, agility and quickness in the football players.

The line graph diagram was used to compare the changes in speed, agility and quickness of the players before and after the 12 week training period. The performance of the

participants is depicted in the figure 4a, 4b and 4c. These figures showed the performance improvement of all three components. The results clearly show that the HIIT exercises improved speed and agility of the participants. These graphs improve our understanding of the study results. We are able to understand the outcomes more in details with this statistical and visual data.



Figure 4a. Speed performance of the players



Figure 4b. Agility performance of the players



Figure 4c. Quickness performance of the players

## Discussion

The study clearly shows that the individuals who completed the 12-week High-Intensity Interval Training (HIIT) program had a substantial advantage in improving their speed and agility. The SAQ (Speed, agility, and quickness) were considerably improved in the HIIT group compared to the control group. This clearly shows that male football players may increase their speed and agility using our HIIT program. For several reasons, the HIIT group did better than the others. At first, their muscles and nerves are adapted to one another more quickly. This implies that there is a greater activation of muscle fibers, which results in stronger and more coordinated muscles. Their bodies learned to use energy more effectively through this intense exercise. It helps to improve performance and recovery speed. The Increased performance and recovery speed are the outcome of the improved anaerobic and aerobic energy systems by HIIT program. This study supports the idea that high-intensity interval training (HIIT) can improve male football players' speed and agility. The improvements of muscle and neuron function in the HIIT group are due to the effective usage of energy during workout.

While the control group did not exhibit significant improvements in SAQ, it is important to explore potential reason for their minimal changes. One possibility is that the control group may have been at a high level of performance, making it difficult to observe significant improvements. Their regular training program might have been challenging to maintain their current level of performance. The individual differences in physical attributes, training responses and motivation levels can also influence the outcomes. Additionally, the tests used to measure SAQ might not have been sensitive enough to detect small changes in performance. Beyond training, factors like nutrition, sleep and injury management also play an important role in athletic performance.

The absence of significant differences in the results may be attributed to several factors. It is possible that the intensity of the training sessions was not sufficient to stimulate measurable changes. Furthermore, individual differences in baseline fitness levels, recovery capacities, and the impact of external variables such as diet and sleep may have influenced the outcomes.

These findings are consistent with earlier studies showing the positive impacts of HIIT on sports performance. HIIT training can help athletes and coaches become more adept at changing direction and moving quickly. However, we must remember that there are a number of limitations with this study. It is inappropriate to generalize these results to the whole football player population as the study focused on a small sample of male football players. Furthermore, it is possible that the twelve-week trial period was insufficient for measuring the long-term advantages of HIIT. In addition, the participants were not controlled on their diet habits in both experimental and controlled groups. The diet habit might have affected the performance of the players.

The further studies should incorporate the longer time duration of this intervention program to evaluate the long-term effect of the HIIT program. Also, the female football

players may be included in the training program for a complete assessment of the program. These research proposals would address the limitation of the current research work. Then, we could evaluate the sustainability of the proposed HIIT intervention program. Future research may include other training modalities along with the proposed HIIT program to understand more about the intervention program. These modalities might be plyometric and strength training. These research studies will fill the research gap for improvement of the HIIT program. These research findings are important to prepare a training program and implement it in a practical sports environment. So, the coaches and players enhance their knowledge on this kind of HIIT program. The current research findings clearly confirmed that the HIIT program improved the speed, agility and quickness of the male football players. The proposed HIIT regimens have a potential to improve SAQ abilities of the players. The additional research might be needed to fully understand the long-term impact of HIIT intervention program. The additional research may be required to find the relationship between HIIT program and other alternative methods. Also, the future research may find the adaptability of this HIIT program in various sports and games. Hence, the sports community may take informed decision through these research initiatives.

## Implications of findings

The study result confirmed the High-Intensity Interval Training (HIIT) program increased the speed, agility and quickness performance of the participants. This study highlights the introduction of HIIT regimens in the training program for the considerable improvement in the performance. The modern football game demands the exceptional abilities of speed, agility and quickness in the players. These important abilities could be improved by implementing our proposed HIIT program in training plan. The proposed HIIT program optimize the muscular function and energy system to improve the speed, agility and quickness of the players. Coaches can use this HIIT program to prepare an effective training program for the football players. This focused training program would improve the speed, agility and quickness of the players. The common training modalities like weightlifting, plyometrics and game-simulation could improve the performance of the player along with this HIIT regimens. Although this study focuses only on male football players, the additional research might be needed to explore the full potential of the HIIT for female players. This research will study the same result is attained in the female players through HIIT program. Hence, the result of this study confirmed the High-Intensity Interval Training (HIIT) would useful in improving speed, agility and quickness of the players. The coaches and players can optimize their efforts by understanding the outcome of this HIIT intervention study [3]. While this study focuses on football, the findings are applicable to a wide range of athletes and sports professionals, including physiotherapists. The HIIT framework can be adapted to improve functional fitness in non-athletic populations as well, making it a valuable tool in physiotherapy and rehabilitation settings.

### Mechanisms Underlying Effects

The strong physiological adaptation might be understood from the results of improved performance of SAQ abilities through the HIIT program. Although this study had some limitations, the statistical analysis report validates the logical reason for this improvement. The observed performance result may be due to the neuromuscular changes by HIIT program. The HIIT program improves brain signal response time and muscular coordination. This improvement increases the speed and agility performance. Besides, it is possible that the energy system might have been improved through this HIIT program. The High-Intensity Interval Training (HIIT) is mainly used in improving the anaerobic and aerobic energy systems. The anaerobic system helps during the intense exercises and aerobic system reduces tiredness of the player. This results in improved performance of speed, agility and quickness. The HIIT program improves the ability to move their muscles with less energy. Thus, the HIIT program improve the performance of SAQ abilities. Although these initial findings are encouraging for male football players, the more research findings are needed to confirm the broader application of HIIT regimens.

The experimental group have shown better results due to improvement of their neuromuscular and metabolic adaptation. The HIIT program might have supported the resilience and determination of the participants. These psychological factors are also important for players. The future study should analyze the neurological adaptation of the players through this HIIT program. Besides, the physiological factors will also be considered for future studies to understand the impact of HIIT program on speed, agility and quickness. If we have more knowledge about these facts, we can prepare an efficient intervention program for football players. Coaches and trainers can implement the HIIT program effectively with this research knowledge.

### Practical Implications

The present study can directly benefit the coaches, players and scientists in the sports community. This study confirms that the football players can improve their speed, agility and quickness through this High-Intensity interval Training (HIIT) regimens. The statistical results ensure the importance of HIIT regimens in football training program plan. Coaches can improve the training program for their players with the results of this intervention study. The HIIT program will improve the overall performance of the players in the sports. Generally, coaches will prepare a training plan to accommodate the individual skill to get better results. Each individual will have different skills, experience and game objectives. So, the coaches has to prepare a customized training plan for each players. The same training plan for all participants will not produce good results. So, the training plan must be customized with HIIT regimens to meet the individual demands of the players. The proposed HIIT program will be applicable to all skill level of the players. It is a quick and efficient approach for improving fitness, speed, power, and endurance. HIIT can be incorporated by athletes into their training regimens to support their particular sports

and performance objectives. They must understand the importance of continuing to exercise at the proper volume, intensity, and rest intervals. This helps them increase their athleticism and gaming performance. The study offers the strong evidence in support of HIIT in football practice. It is an important instrument for athletes to improve their performance because of its effectiveness. Coaches and athletes should introduce HIIT into their training plans in order to maximize performance.

A complete training program should include a variety of training methods in order to maximize the growth of athletes. Athletes can perform well by integrating high-intensity interval training (HIIT) with skill-specific drills, plyometric training, and strength training. This comprehensive strategy has the potential to improve performance across a variety of athletic areas. The informed decisions in addition to working hard is necessary for achieving the optimized performance. The study emphasizes the necessity of focusing on one aspect rather than all the variables that athletes must manage to perform well. This includes healthy diet, injury avoidance techniques and enough sleep. Football coaches and players can maximize their performance and realize their maximum potential by integrating HIIT with these fundamental components. There is opportunity for more research on the best use of HIIT, even though the current study offers insightful information.

This includes identifying the best frequency, duration, and intensity of HIIT for each athlete. Sports science will advance through an understanding of the unique physiological changes caused by HIIT and their long-term implications for performance. The findings of this study provide important proof of HIIT training for football players. Coaches and athletes can maximize their performance by working together by keeping a holistic approach.

### Limitations and Future Directions

It is important to examine a number of aspects for the performance of football players while the study provides the evidence for the benefits of HIIT in improving their speed and agility. The findings may not be as generalizable to the larger athlete community due to the relatively small sample size of 30 participants. An extensive understanding of the effects of HIIT exercise would be possible with an increased sample size. The study limits its ability to draw conclusions about the impact of HIIT on female athletes. More research is needed to see if female players may attain similar benefits. A twelve-week period is sufficient to identify early adaptations to HIIT, but longer-term research is required to grasp the entire range of its effects on performance. Future study should include stagnation, adaptations, and overtraining. The absence of food monitoring in the study is a drawback because diet has a big impact on training adaptations and athletic performance. Even though the findings are encouraging, more research is needed to fully understand the long-term effects of HIIT.

The controlled surroundings of a lab may not always present the same challenges as real-world football games. The future study must analyze the application of this HIIT program in a real game environment. The female participants were included in

the study to understand the impact of HIIT on female players. The limitation of the current research work can be addressed by increasing the intervention time duration. Researchers may include the other training modalities like weightlifting, plyometrics and diet control along with proposed HIIT program for understand the implication of intervention. The future research may be done on real game environment for finding the application of proposed HIIT regimens. These findings will provide the comprehensive information to include HIIT into football training. However, the future researches are important to explore the full potential of the HIIT intervention program. These recommendations can be implemented in future studies to optimize the implementation of HIIT program.

### Conclusion

The objective of this study was to understand the impact of High-Intensity Interval Training (HIIT) regimens on speed, agility and quickness (SAQ) of male football players. The statistical results confirmed the proposed HIIT program improved the SAQ of the football players. The experimental group showed the higher average scores for speed (5.29 vs. 5.28), agility (17.71 vs. 17.56), and quickness (0.23 vs. 0.24) after the HIIT program. This statistical data analysis ensures the HIIT intervention improved the performance of the players. The football players require the SAQ abilities to outmaneuver the opponents in game. Also, the High-Intensity Interval Training could improve the metabolic activity and neuromuscular adaptation of the players.

### Acknowledgement

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Furthermore, this study highlights the importance of a customized training program for better athletic performance. The customized HIIT program may include strength training, diet plans and recovery techniques. The study recognizes the limitation of male players, sample size and short time duration. We recommend a number of future research designs to address the current study limitations. In conclusion, this study provides the static information about HIIT intervention program for improving the speed, agility and quickness (SAQ) in the male football players. Coaches and players can use this evidence-based information to optimize the training program for overall performance improvement. Although no significant differences were observed between the experimental and control groups, this study highlights areas for improvement in future research. Increasing the intervention duration beyond 12 weeks, using a larger sample size, and controlling external factors such as diet and recovery could yield more substantial outcomes.

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# Impact Of High-Intensity Interval Training On Specific Physical Factors Among College Male Football Players

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## Abstract

The aim of this study was to examine the impact of high-intensity interval training on specific physical variables among college male football players. To achieve this goal, 30 subjects were randomly chosen from G.T.N Arts College(Autonomous) Dindigul, aged between 18 and 24 years. These selected individuals were then randomly assigned to two groups, each consisting of 15 participants: an experimental group and a control group. The experimental group underwent a high-intensity interval training regimen, while the control group did not engage in any experimental activities. The physical fitness variables focused on in this study were agility and muscle strength. The research design followed a true random group design, including both pre-tests and post-tests. All 30 subjects were evenly distributed between the experimental group (comprising the high-intensity interval training group) and the control group. Before the six-week experimental period, pre-tests were administered to assess the selected physical variables in all 30 subjects. Following the experimental period, post-tests were conducted, and the scores were diligently recorded. Statistical analysis was carried out with a predetermined significance level set at 0.05 confidence. The results of this study indicated a significant improvement in agility and muscle strength among participants in the high-intensity interval training group.

**Keywords:** agility, muscle strength, football players

## Introduction

### Football

Football is a ball game played on a large rectangular grass or simulated turf field with eleven players on each side, and there is a goal at each end. The objective of the game is to score by maneuvering the ball into the opponent's goal. During regular play, only the goalkeeper is allowed to use their hands or arms to handle the ball; the rest of the team typically employs their feet to kick the ball, occasionally utilizing their torso or head to intercept a ball in midair. The team with the most goals at the end of the match is declared the winner. In the case of a tie, the game may result in a draw, or extra time and/or a penalty shootout may be played, depending on the competition format. Football is one of the most popular sports worldwide, played by individuals of various ages and skill levels.

Football players run swiftly to acquire the ball or score, evade defenders for scoring or passing, and engage in actions such as jumping for heading or receiving the ball throughout the 90-minute game or even longer. Given the prolonged duration of the game, aerobic capacity plays a significant role in sustaining optimal performance. In addition to aerobic capacity, football players require other crucial physical fitness components like speed, agility, explosive strength, coordination, and kinesthetic ability to deliver top-notch performances. The Indian football team has achieved notable success in various areas contributing directly or indirectly to enhanced sports performance, such as physical fitness, psychological fitness, technical and tactical aspects.

Nevertheless, to attain the highest level of performance comparable to leading football teams like Brazil, Argentina, France, Spain, Germany, England, Uruguay, etc., the Indian team management, including the government of India, must focus on developing football performance through the implementation of various sports schemes and addressing issues such as corruption in the sports field.

The durations of both high-intensity and low-intensity intervals can vary from 10 seconds to 4 minutes. Shorter high-intensity intervals (10-30 seconds) activate the anaerobic system for energy, while longer high-intensity intervals (more than 30 seconds) engage the aerobic system for energy. Typically, a high-intensity interval training workout, which includes warm-up and cool-down, can be completed within 30 minutes, depending on the workout's intensity. The popularity of high-intensity interval training workouts has grown due to their ability to deliver similar health benefits to steady-state moderate-intensity exercise in significantly less time.

In recent years, High-Intensity Interval Training (HIIT) has been advocated as the preferred exercise method when time is limited. In football (soccer), both aerobic and anaerobic metabolism are crucial. Given the

prolonged nature of the game, aerobic capacity is essential, while anaerobic power plays a vital role in short



bursts of running with and without the ball, kicking, heading, and throwing. Endurance athlete training typically emphasizes long-duration, low- or moderate-intensity exercise during the base or preparation phase, with short-duration, high-intensity efforts as the competitive phase approaches. It has been demonstrated that High-Intensity Training (HIT) produces faster results than traditional training methods. High Resistance Interval Training has also shown significant benefits for elite athletes.

### Methodology

The researcher utilized a randomized design, incorporating both pretests and post-tests. A total of 30 male football players (N=30) were randomly assigned to two equal groups, each comprising 15 participants: the experimental group and the control group. Prior to the initiation of any training, a pre-test was administered to evaluate selected physical fitness variables, specifically agility and muscle strength, for all 30 football players. Following this, the experimental group underwent a six-week regimen involving high-intensity interval training, while the control group did not engage in any training activities. Upon the conclusion of the six-week training period, post-tests were conducted to measure the same dependent variables. The data obtained from these tests underwent statistical analysis using the dependent t-test to ascertain if any statistically significant improvements were observed. It is important to note that a significance level was set at 0.05, ensuring a 95% confidence level for all analyses.

### Test I Mean and Dependant ' T' – ratio for the Pre and Post Tests on high intensity interval training group and control Group on agility

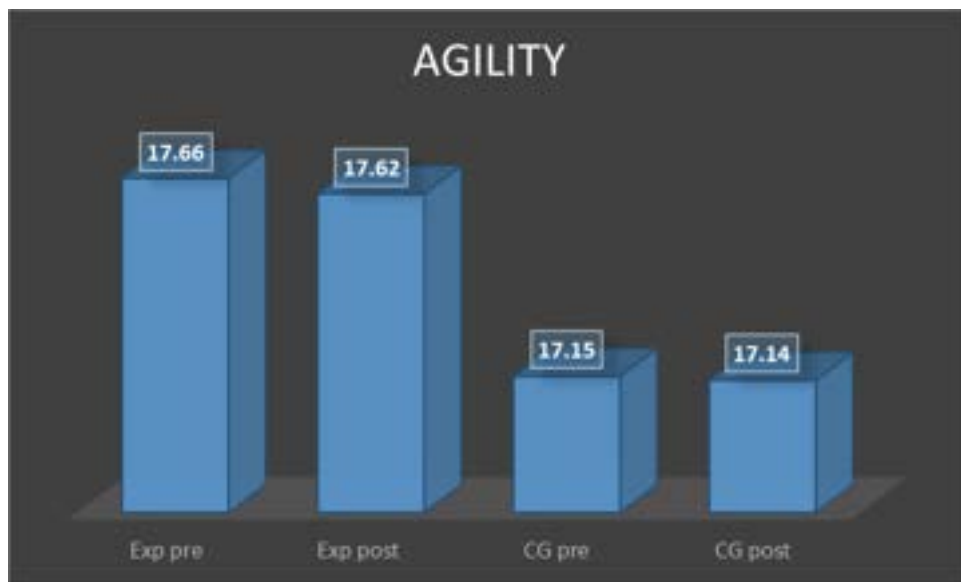
Group	Test	Mean	Standard deviation	Standard error mean	t- ratio
Experimental group	Pre test	17.66	3.16	0.18	4.76*
	Post test	17.62	3.20		
Control group	Pre test	17.15	3.46	0.19	1.81
	Post test	17.14	3.22		

\*Significant level 0.05 level degree of freedom (2.14, 1 and 14)

Table I illustrates the calculation of the 't' ratio comparing the means of pre-test and post-test agility scores for college-level football players. The mean agility values for the experimental group were 17.66 before training and 17.62 after, while the control group had means of 17.15 and 17.14 for the respective tests. The computed 't' ratio of 4.76 surpassed the critical table value of 2.14, indicating statistical significance for 1 degree of freedom and 14 participants at a 0.05 level of confidence. This result strongly suggests that the agility of the experimental group significantly improved due to the influence of in-and-outs high-intensity interval training. In contrast, the calculated 't' ratio of 1.81 fell short of the critical table value of 2.14, making it statistically non-significant for 1 degree of freedom and 14 participants at a 0.05 level of confidence. This outcome clearly indicates that the agility of the control group did not show significant improvement following the intervention.

The bar diagram shows the mean values of pre test on agility of control group and experimental group.

### Bar diagram





**Test II Mean and Dependant ' T ' – ratio for the Pre and Post Tests on high intensity interval training group and control Group on muscle strength**

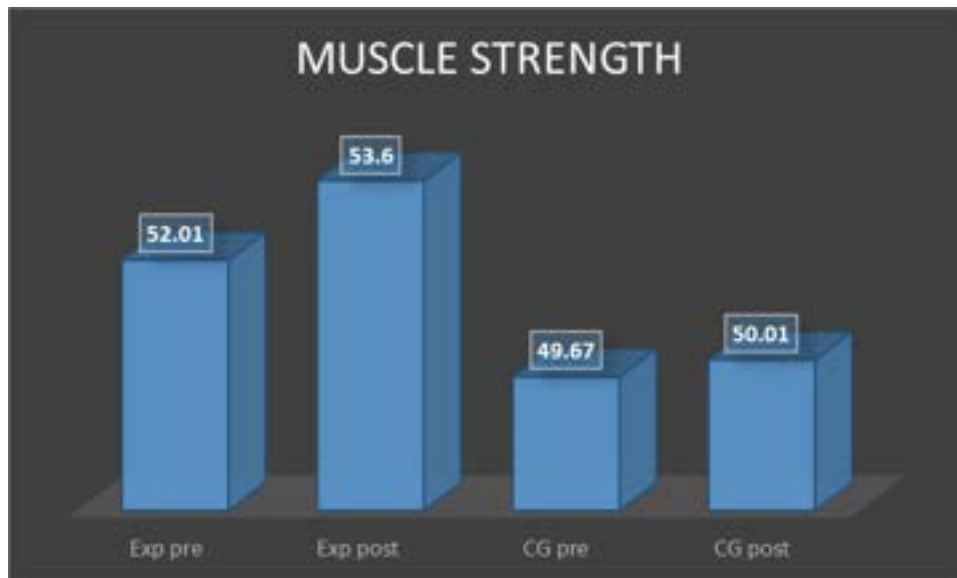
Group	Test	Mean	Standard deviation	Standard error mean	t- ratio
Experimental group	Pre test	52.01	0.03	0.45	2.28*
	Post test	53.60	0.04		
Control group	Pre test	49.67	0.04	0.06	1.44
	Post test	50.01	0.04		

\*Significant level 0.05 level degree of freedom (2.14, 1 and 14)

Table II outlines the computation of the 't' ratio, comparing the means of pre-test and post-test muscle strength scores among college-level football players. The mean values for the experimental group were 52.01 before training and 53.60 after, while the control group had means of 49.67 and 50.01 for the respective tests. The calculated 't' ratio of 2.28 exceeded the critical table value of 2.14, indicating statistical significance for 1 degree of freedom and 14 participants at a 0.05 level of confidence. This outcome strongly suggests that the muscle strength of the experimental group significantly improved due to the influence of in-and-outs high-intensity interval training. In contrast, the computed 't' ratio of 1.44 fell short of the critical table value of 2.14, making it statistically non-significant for 1 degree of freedom and 14 participants at a 0.05 level of confidence. This result clearly indicates that the leg explosive power of the control group did not show significant improvement following the intervention.

The bar diagram shows the mean values of pretest on muscle strength of control group and experimental group.

**Bar diagram**



**Discussion on Finding**

The study's findings highlight a significant improvement in the selected variables—agility and muscle strength—within the experimental group, comprising individuals undergoing game-high intensity interval training. This improvement is compared to the control group. Moreover, the study suggests that the enhancements achieved by the game-high intensity interval training group are notably superior to those observed in the control group. For further insights on this topic, one can refer to the research conducted by R. Saravanan and Pushpa in their study titled "THE EFFECT OF HIGH INTENSITY INTERVAL TRAINING WITH SPECIFIC DRILL TRAINING ON PERFORMANCE VARIABLES AND SKILL PERFORMANCE OF ELITE VOLLEYBALL PLAYERS." In conclusion, the study's results underscore the positive impact of high-intensity interval training on agility and muscle strength, emphasizing its effectiveness in enhancing athletic performance

**Conclusions**

From the analysis of the data the following conclusions are



1. The experimental group, consisting of individuals who participated in a high-intensity interval training program, demonstrated a notably significant improvement in physical fitness variables, particularly agility and muscle strength, among college-level football players.
2. On the contrary, the control group showed negligible improvement in physical fitness variables, such as agility and muscle strength, among college-level football players.

### Reference

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