Scientiarum: A Multidisciplinary Journal
Volume 1, Issue 5, October 2025, pp. 1–10
DOI: 10.54646/SAPARS.2025.23

RESEARCH ARTICLE

Effect of specific conditioning training on selected physical components of football players

T. P. Anand, Jeji John Abraham and T. Alwin Mathew

Department of Physical Education, School of Physical Education and Sports Sciences Mahatma Gandhi University, Kottayam, India

***Correspondence:**
T. P. Anand,
anandtprrrr@gmail.com

Received: 30 September 2025; **Accepted:** 06 October 2025; **Published:** 18 October 2025

Football (soccer) has been recognized as the "beautiful game" for its simplicity, rapid pace and various forms of scoring. In recent years, football has grown rapidly in terms of its worldwide audience and popularity. This rapid growth has caused an increased amount of research and discussion about ways to improve a player's ability to play the game effectively. The purpose of this study is to investigate the effectiveness of a conditioning program designed to improve both aerobic and anaerobic endurance as well as the agility of high school level players. A total of 40 male high school players aged 14–17 years of age from the state of Kerala, India, were selected for the study using random assignment to either control or experimental groups. The Experimental group of players were placed through a 6-week conditioning program using circuit-based conditioning exercises while the Control group players followed their normal training. Two performance tests were used to measure the players' performance; the Arrowhead Agility Test was used for measuring agility, and the Sprint Fatigue Test was used for measuring anaerobic endurance. Both test methods provided numerical data that were easily reduced to statistical values and subjected to both paired sample and independent t-tests at the.05 level. Results showed that while the just acuity and anaerobic endurance measures improved during the experimental group's post-test, no improvement in agility and Level III anaerobic endurance measures was observed in the experimental group post-test compared to the control group. The results of this study show us the need to incorporate sport-related conditioning drills into football training programs as means of enhancing the major physical fitness parameters needed by footballers. The study plays a key role in expanding our current understanding of sports science with regards to both sport-related drills, as well as scientifically designed sport specific drills as a way of increasing the level of an athlete's performance. Thus, these results may prove beneficial to both football practitioners and coaches.

Keywords: football, agility, anaerobic endurance, conditioning training, high school athletes, sports science

Introduction

Football is the most popular sport in the world, with millions of fans and supporters across the world. The simple fact that football can be played in the street, at the playground, in schools, and on professional fields has contributed to football's popularity. FIFA estimated that the sport is played by over 250 million players and that 1.3 billion people follow football very closely. With its significant popularity and cultural relevance, football is an area of study for sports scientists, coaches, and educators.

Football is physically demanding. Players are expected to demonstrate technical skills (dribbling, passing, shooting) at the same time as playing at physically demanding levels (speed, agility, power, and endurance) (Loturco et al., 2019; Slimani and Nikolaidis, 2019). Compared with the past, the speed of the modern game has changed dramatically, with players expected to regularly complete short sprints, react quickly to change of direction, and maintain energy for long matches (Beato et al., 2019). Agility and anaerobic endurance are particularly important for performance, allowing for the ability to react to the dynamic context of the game and for players' performance to be sustainable over the duration of the match (Van de Hoef et al., 2019).

As evidence-based instruction becomes increasingly valued, sports scientists have examined a range of conditioning programs to develop athletes' performance. Historically, training programs have relied on the development of skills and components of general fitness; however, a growing body of research contributes to the importance of conditioning programs with the intent to address the specific demands, both physical and physiological, experienced in football (Azmi and Kusnanik, 2018; Pricop et al., 2022; Brito et al., 2020; Raya-González et al., 2021). These programs help in targeting some specific abilities such as agility and anaerobic endurance, which helps the athletes to prepare effectively for the competition (Oliveira et al., 2020).

The last decade of research has provided evidence to suggest that structured training programs, including plyometric drills, short sprint intervals, and circuit-based programs for conditioning, can significantly enhance football-specific performance measures including agility and anaerobic endurance (Koral et al., 2018; Hernandez et al., 2018; Monks et al., 2021). Agility training has demonstrated improvements in an athlete's ability to change direction rapidly while remaining controlled in the movement (Clemente et al., 2021). Anaerobic endurance training improves the system's capacity to continue repeated bouts of effort, particularly training to match the demands required in competitive football (Ramirez-Campillo et al., 2019). Furthermore, these fitness domains and measures can be associated with reduced risk of injury, increased match efficiency and improved overall physical development as a football player (Raya-González et al., 2021).

Although the amount of literature continues to grow, it is important in the future to research individual school-level players. Most of the existing research samples elite, or semi-professional athletes, so we do not have a good understanding of how conditioning programs may (or may not) impact younger developing athletes. Early intervention is important because adolescence is a period of rapid growth and development both physically, and skills/ability (Lesinski et al., 2018; Yanci et al., 2019). For this reason, this study looks to investigate the possible benefits from a 6-week specific conditioning training program on agility and anaerobic endurance of high school football players in Kerala.

The study's practical implications will hopefully serve both to provide more scientific literature, but also ways for practical coaches. The results from the study will allow better training practices for young athletes, while coaches and physical education people will benefit by integrating evidence into their programming (Rodriguez-Fernandez et al., 2019). More generally, the study will promote the need for scientifically designed conditioning programs in the school sport system to attract future athlete talent and improve performance measurements (Stojanović et al., 2018).

In the last decade, research into football training has focused on structured conditioning programs to improve fitness-related performance attributes such as agility, endurance, and speed (Beato et al., 2019). Football needs both strength and pace, so fitness training is must for the players. Simultaneously players should also learn about skills and tactics of the game. For rookies who are trying to be a good footballer means developing both fitness and skills together. (Slimani and Nikolaidis, 2019). Recent studies are providing more evidence that these types of training interventions can build not just fitness-related improvements, but increased performance within match day scenarios (Van de Hoef et al., 2019).

Structured training and athletic development

Current research has adopted a common theme in the literature which is the role of structured, sport-specific training programs to improve performance (Raya-González et al., 2021). Historically, football training practices often orientated towards technical and tactical modules, but through recent studies, we know that purposeful motor programs, designed in a scientific manner, can improve physical and physiological characteristics. Pricop et al. (2022) conducted a study examining the effects of structured programs amongst young football players, and by virtue of their findings demonstrated marked improvements in measures of running speed, endurance, and abdominal strength (Brito et al., 2020).

In addition to the previous studies, Zhang et al. (2022) looked at the effect of after-school football on children's physical fitness levels. They found increases in basic physical qualities and showed that regular participation in a sport-specific program improved overall athletic ability in children (Rodriguez-Fernandez et al., 2019; Yanci et al., 2019).

Core training and agility

Agility is a key performance factor in football, as it allows the player to change direction quickly, avoid another player, or react to the unknown aspects of a football game. For this reason, research has begun to emphasize training methods that can improve this ability. Doganay et al. (2020) investigated how core training affected agility and quickness in adolescent football players and showed that agility and quickness significantly improved after the core training intervention. Because core stability provides a strong base for vertical and explosive movements, it is no surprise the researchers found support for the notion that strengthening the stabilization musculature in the center of the body builds a more functional athlete in terms of agility and general performance.

Furthermore, agility training is frequently combined with exercises that develop neuromuscular coordination. The strengthening of stabilizing muscles and improvement of neuromuscular control and body awareness will contribute to quicker change of direction abilities and injury prevention. The combination of these properties has led to the incorporation of core training into the conditioning programs of youth players. Pereira et al. (2019) emphasized that change of direction ability is closely related to speed and muscular power in both male and female soccer players, reinforcing the need to train.

Resistance and plyometric training

Resistance and plyometric training have arguably received the most attention in literature when discussing training methods for improving performance in football. Ghosh and Biswas (2020) compared the two training modes, and they found that resistance and plyometric training help young players to run faster. Resistance training helps in building muscle and strength, while plyometric helps to react more quickly. When these training methods are used together, it improves the player's speed and strength which are useful in a match. Similarly, Hammami et al. (2019) showed that combining plyometric and short sprint training improved enhanced speed, agility, and power in U19 soccer players.

The study found that plyometric training in college football players has made positive improvements in their fitness. Plyometric training helped players became more volatile, and improved their breathing efficiency. This shows that plyometric training is very useful for football players.

Vassil and Bazanov (2018) studied plyometric training in volley ball players and they stated that it greatly improved their ability. Even though the study is on volley ball players the sports involves intense activity similar to football. So, it can be applied to football players due to the similarity. This also further supports the rationale to include plyometric exercises in the resistance training component of a soccer training program.

Sprint interval training and high-intensity training

Training methods characterized as sprint interval training (SIT) and high-intensity interval training (HIIT) are emerging as valuable conditioning modalities in soccer. These methods simulate the intermittent bouts of exercise that are inherent to its game, and thus improves both the aerobic and anaerobic systems of the body. Koral et al. (2018) found that short-term sprint interval training improved the aerobic system, and running performance in trained athletes. Improvements in the aerobic system and running performance may result in improved repeated sprint ability and recovery, which has a positive impact on a soccer player's ability to maintain playing performance over an entire soccer match.

Examined the influence of high-intensity interval training and found that HIIT improved the aerobic system of elite soccer players. The authors noted that the HIIT method of training is effective, time-efficient and provides substantial fitness benefits in a short interval of time. All of this information is consistent with the recent trend of implementing sport specific drills that replicate the intensity patterning of competition.

Integrative approaches and practical implications

In sum, these findings provide strong evidence against the superiority or exclusivity of training modalities. Instead, a balanced and integrative approach seems to provide the best outcome with an array of evidence supporting both muscular strength and explosive power in combination with plyometrics, while higher intensity intervals or sprinting exploits both aerobic and anaerobic endurance. Core training is important for fitness, it helps in improving balance, stability and strength.

These findings show that players need well-planned training programs, for proper development. Based on the developmental stage, in particular youth athletes, specific structured motor plans will offer the best option for developing physical literacy and sports performance history. As athletes develop through playing years, specific evidence can be employed in more rigorous training protocols, such as resistance training and HIIT, while still developing a reduced risk for injury.

Experimental or materials and methods

Participants and sampling

The sample included a total of 40 boys aged 14–17 years, and all were playing football and enrolled in high schools in the state of Kerala. The sample was selected using a convenience sampling approach simply based on those that were available and wanting to participate during the academic year. Convenience sampling can limit how generalizable findings might be, but the researchers found it to be reasonable due to several factors such as time and resource limits, but also due to the practical inclusion of a decentralized youth population of athlete participants.

The participants were randomly assigned to either an experimental group (n = 20) or a control group (n=20). The groups were similar by age, fitness, and playing experience to limit confounds as best as possible. Prior to the study, the participants were told about the purpose and the process of the study. Participants and their guardians signed an informed consent form by recognizing the study was voluntary. Ethical protocols for doing research with minors were followed, including confidentiality and an ability to withdraw and further study.

Testing instruments

Two standardized physical performance tests were utilized to measure the dependent variables of agility and anaerobic endurance:

Arrowhead agility test

The Arrowhead Agility Test is a widely accepted method of evaluating multidirectional movement efficiency, an important skill in football. The Arrowhead Agility Test requires participants to sprint while proceeding through eight sets of rapid changes in direction around cones which are placed in an arrowhead configuration. The time to complete the course is recorded with a stopwatch and less time is better for the Arrowhead Agility Test. The Arrowhead Agility Test was chosen because it has the movements that are used in football, thus arrowhead agility test makes a good test to measure the agility needed in a match.

Sprint fatigue test

The Sprint Fatigue Test was used to measure anaerobic endurance. Players performed different short sprints of same distance and the time taken for each sprint was recorded. As the players got exhausted the time taken to complete the sprint gets slower, which shows how they can handle fatigue. This test suits football because the game involves multiple high-intensity runs with short breaks.

Data collection procedures

Baseline testing was done for both groups before the training. Players were instructed to not to do any hard exercises for 24 hours before testing so tiredness would not be a factor to affect the result. All tests were done in outdoor to keep the results fair.

Data evaluations

The data was analyzed using SPSS software. Two tests were used:

Paired t-tests compared before and after training results to see if there is any improvement.

Independent t-tests compared the final results of training group and normal group to check if special conditioning training worked better.

A significance level of 0.05 was used. The effect size was also obtained to consider whether there was practical significance with the observed differences.

Ethical guidelines

Ethical compliance was a mainspring throughout the study. Each participant was informed about the nature and the purpose of the research, and parental consent was obtained because of their status as minors. All participants were guaranteed that their data would be treated with confidentiality and used only for the study. They were also informed they had the right to withdraw from the study without any repercussion.

Results and discussion

This is the research chapter that contains analysis of collected data (statistical analysis) and the interpretation of collected data through various statistical methods. The term "data analysis" refers to the process of converting the collected data into useful and meaningful information. In this way, several techniques, including modeling techniques, are used to determine trends, identify relationships and reach conclusions regarding the decision-making process. The first step in analyzing data involves defining the issue or problem that you are trying to solve/reach and identifying the relevant or available information; In this phase, the data is summary and exploratory in nature, will use descriptive statistics, data visualization, and more advanced techniques to obtain predictions and/or test ideas. A common use of this phase is to find missing or unusual data points (or “outliers”) in the data, as well as to identify potential patterns that may exist in the data. Once the data is prepared, other types of data analysis techniques (i.e. regression analysis, clustering, classification, and hypothesis testing) can be used to extract useful insights or conclusions.

The insights you obtain can assist you in making better decisions, as well as improve overall efficiency, therefore, a competitive advantage for your business.

Data analysis is not simply about making numerical or statistical computations; It also involves some degree of critical thinking and understanding of the domain in which the data resides in order to draw accurate interpretations of the data collected (Rahman and Islam, 2021). Additionally, there are ethical considerations, such as privacy issues and biases that must be taken into consideration during the analysis process.

In this study, two statistical analysis methods (Paired ‘T’ test and Independent ‘T’ test) were used in order to assess the effectiveness of the training program.

Table 1 presents an age-based distribution of participants who were selected. The fact that there was even distribution across the selected ages guarantees that there will be comparability of the two groups in all areas.

Discussion on findings

Agility

Table 2 shows that the mean and standard deviation of pre-test on agility among control group is 22.438 and 1.661. Mean and standard deviation of pre-test on agility among experimental group is 22.442 and 1.983. Mean and standard deviation of post-test on agility among control group is 22.542 and 1.813. Mean and standard deviation of post-test on agility among experimental group is 21.388 and 1.696.

Table 3 indicates that the mean and standard deviation of pretest on agility on control group is 22.438 and 1.661. Mean and standard deviation of pre-test on agility among experimental group is 22.442 and 1.983. The mean difference is -0.004 and the calculated t value and p value is 0.004 and 0.995. Since the calculated t value 0.004, which is less than the table value of 2.024 with df 38 at 0.05 level, it is concluded that there is no significant difference between experimental group and control group during pre-test.

Table 4 indicates that the mean and standard deviation of post-test on agility on control group is 22.542 and 1.813. Mean and standard deviation of pre-test on agility among experimental group is 21.388 and 1.696. The mean difference is 1.154 and the calculated t value and p value is 2.078 and 0.044. Since the calculated t value 2.078 is more than the table value of 2.024 with df 38 at 0.05 level, it is concluded that there is a significant difference between experimental group and control group during post-test.

Table 5 indicates that the mean and standard deviation of pre-test on agility on control group is 22.438 and 1.661. Mean and standard deviation of post-test on agility among control group is 22.542 and 1.813. The mean difference is -0.104 and the calculated t value and p value is -1.563 and 0.135. Since the calculated t value 1.536 is less than the table value of 2.093 with df 19 at 0.05 level, it is concluded that there is no significant difference between pre and post-test of agility on control group.

Table 6 indicates that the mean and standard deviation of pre-test on agility on experimental group is 22.442 and 1.983. Mean and standard deviation of post-test on agility among experimental group is 21.388 and 1.696. The mean difference is 1.449 and the calculated t value and p value is 3.748 and 0.001. Since the calculated t value 3.748 is more than the table value of 2.093 with df 19 at 0.05 level, it is concluded that there is a significant difference between pre and post-test of agility on experimental group.

Anaerobic endurance

Table 7 shows that the mean and standard deviation of pre-test on anaerobic endurance among control group is 86.910 and 3.684. Mean and standard deviation of pre-test on anaerobic endurance among experimental group is 88.063 and 2.087. Mean and standard deviation of post-test on

TABLE 1 | Age-wise distribution of subjects.

Age	Frequency	Valid percent	Cumulative percent
14	10	25.000	25.000
15	15	37.500	62.500
16	8	20.000	82.500
17	7	17.500	100.000
Total	40		

TABLE 2 | Pre- and post-test agility scores of controls and experimental groups.

	Pre-test		Post-test	
	Control group	Experimental group	Control group	Experimental group
Valid (n)	20	20	20	20
Mean	22.438	22.442	22.542	21.388
Std. deviation	1.661	1.983	1.813	1.696

TABLE 3 | Independent t-test for pre-test agility scores of control and experimental groups.

Pre-test	Mean	SD	Mean difference	T-ratio	P-value
Control group	22.438	1.661			
Experimental group	22.442	1.983	-0.004	0.004	0.995

TABLE 4 | Post-test agility t-test results.

Post-test	Mean	SD	Mean difference	T-ratio	P-value
Control group	22.542	1.813			
Experimental group	21.388	1.696	1.154	2.078	0.044

TABLE 5 | Paired t-test of pre- and post-test agility in control group.

Control group	Mean	SD	Mean difference	T-ratio	P-value
Pre-test	22.438	1.661			
Post-test	22.542	1.813	-0.104	1.563	0.135

TABLE 6 | Paired t-test of pre- and post-test agility in experimental group.

Experimental group	Mean	SD	Mean difference	T-ratio	P-value
Pre-test	22.442	1.983			
Post-test	21.388	1.696	1.054	3.748	0.001

TABLE 7 | Anaerobic endurance pre- and post-test scores.

	Pre-test		Post-test	
	Control group	Experimental group	Control group	Experimental group
Valid (n)	20	20	20	20
Mean	86.910	88.063	87.657	89.954
Std. deviation	3.684	2.087	2.208	1.434

anaerobic endurance among control group is 87.657 and 2.208. Mean and standard deviation of post-test on anaerobic endurance among experimental group was 89.954 and 1.434.

Table 8 indicates that the mean and standard deviation of pretest on anaerobic endurance on control group is 86.910 and 3.684. Mean and standard deviation of pre-test on anaerobic endurance among experimental group is 88.063 and 2.087. The mean difference was -1.153 and the calculated t value and p value is 1.218 and 0.231. Since the calculated t value 1.218 is less valuable than the table value of 2.024 with df 38 at 0.05 level, it is concluded that there is no significant difference between experimental group and control group during pre-test.

Table 9 indicates that the mean and standard deviation of post-test on anaerobic endurance on control group is 87.657 and 2.208. Mean and standard deviation of pre-test on anaerobic endurance among experimental group is 89.954 and 1.434. The mean difference was -2.297 and the calculated t value and p value is 3.902 and <0.001. Since the calculated t value 3.902 is more than the table value of 2.024 with df 38 at 0.05 level, it is concluded that there is a significant difference between experimental group and control group during post-test.

Table 10 indicates that the mean and standard deviation of pre-test on anaerobic endurance on control group is 86.91 and 3.684. Mean and standard deviation of post-test on anaerobic endurance among control group is 87.657 and 2.208. The mean difference is -0.746 and the calculated t value and p value is 1.495 and 0.151. Since the calculated t value 1.495 is less than the table value of 2.093 with df 19 at 0.05 level, it is concluded that there is no significant difference between pre and post-test of anaerobic endurance on control group.

TABLE 8 | Pre-test anaerobic endurance t-test.

Pre-test	Mean	SD	Mean difference	T-ratio	P-value
Control group	86.910	3.684			
Experimental group	88.063	2.087	-1.153	1.218	0.231

TABLE 9 | Post-test anaerobic endurance t-test.

Post-test	Mean	SD	Mean difference	T-ratio	P-value
Control group	87.657	2.208			
Experimental group	89.954	1.434	-2.297	3.902	<0.001

Table 11 indicates that the mean and standard deviation of pre-test on anaerobic endurance on experimental group is 88.063 and 2.087. Mean and standard deviation of post-test on anaerobic endurance among experimental group is 89.9540 and 1.434. The mean difference is -1.890 and the calculated t value and p value is 4.386 and <0.001. Since the calculated t value 4.386 is more than the table value of 2.093 with df 19 at 0.05 level, it is concluded that there is a significant difference between pre and post-test of anaerobic endurance on experimental group.

TABLE 10 | Paired t-test of anaerobic endurance in control group.

Control group	Mean	SD	Mean difference	T-ratio	P-value
Pre-test	86.910	3.684			
Post-test	87.657	2.208	-0.746	1.495	0.151

TABLE 11 | Paired t-test of anaerobic endurance in experimental group.

Experimental group	Mean	SD	Mean difference	T-ratio	P-value
Pre-test	88.063	2.087			
Post-test	89.954	1.434	-1.890	4.386	<0.001

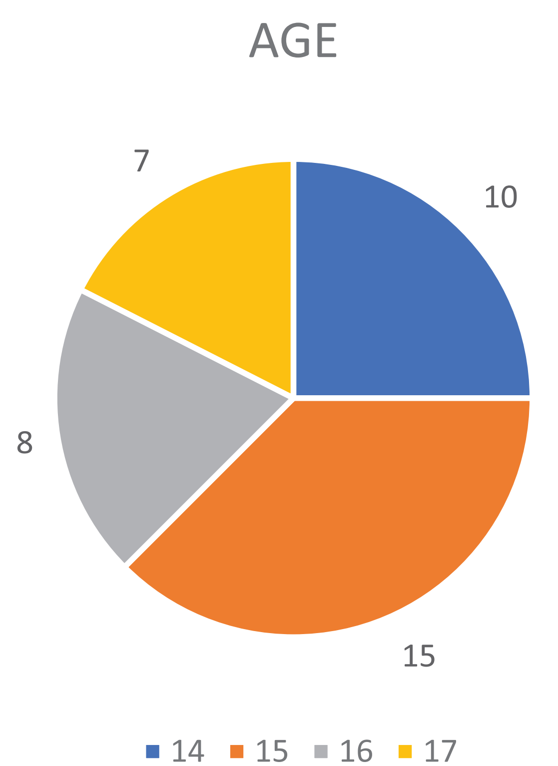

FIGURE 1 | Age-wise distribution of subjects.

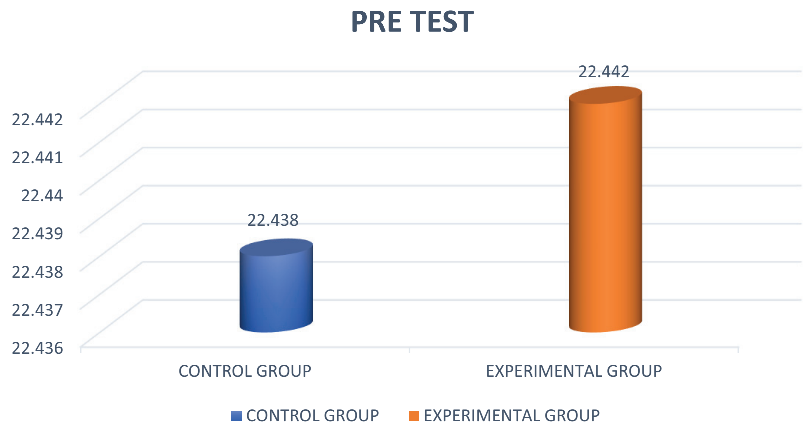

FIGURE 2 | Pre-test agility of control and experimental groups.

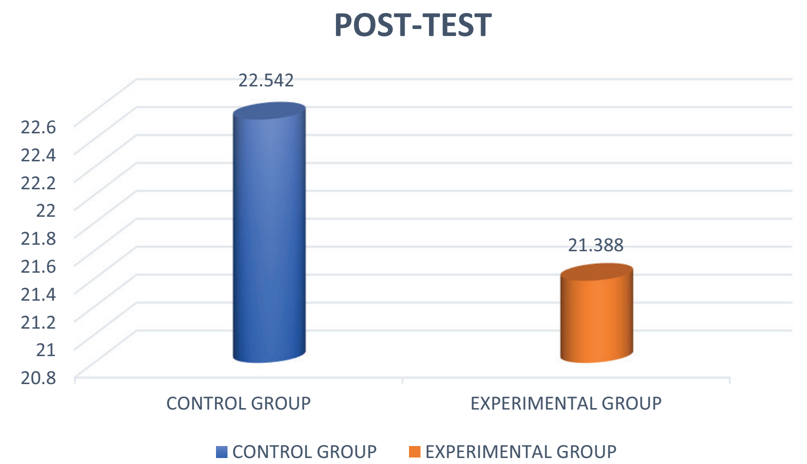

FIGURE 3 | Post-test agility of control and experimental groups.

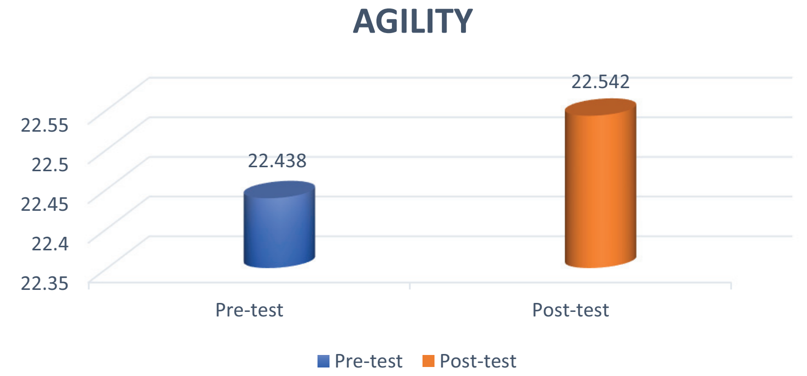

FIGURE 4 | Pre- and post-test agility of control group.

Discussion on hypothesis

H1: It is hypothesiszed that there will be significant improvement in agility due to specific conditioning training on experimental group when compared to the control group. The statistical analysis employed a significance level of 0.05 and yielded a p-value of <0.001. Since the p-value (<0.001) is smaller than the chosen significance level (0.05), the hypothesis is accepted (**Figures 1–5**).

H2: It was hypothesized that there will be significant improvement in anaerobic endurance due to specific conditioning training on experimental group when compared to the control group. The statistical analysis employed a significance level of 0.05 and yielded a p-value of 0.044. Since the p-value (0.044) is smaller than the

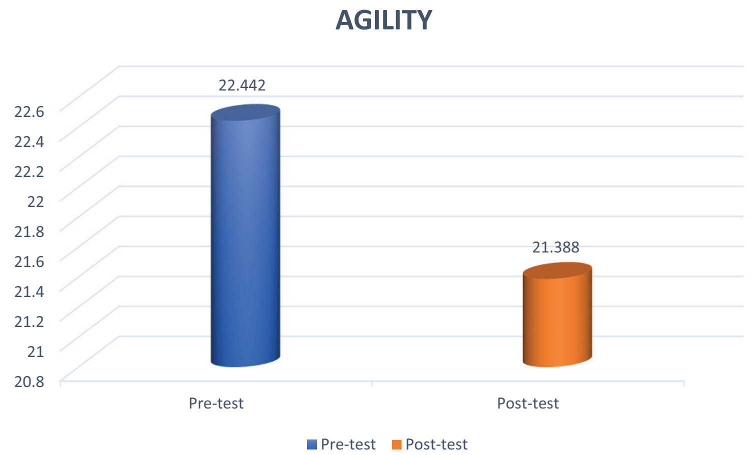

FIGURE 5 | Pre- and post-test agility of experimental group.

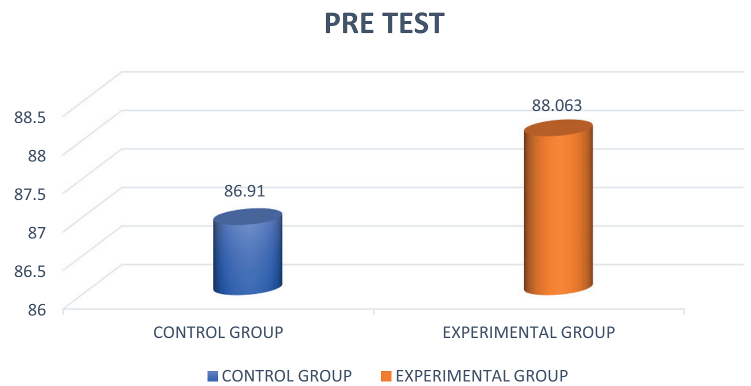

FIGURE 6 | Pre-test anaerobic endurance of control and experimental groups.

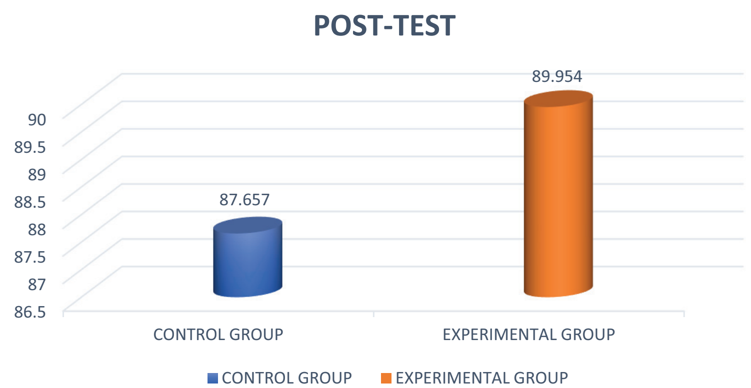

FIGURE 7 | Post-test anaerobic endurance of control and experimental groups.-wise distribution of subjects.

chosen significance level (0.05), the hypothesis is accepted (**Figures 6–9**).

Conclusion

The current study aimed to analyze the impact of a 6-week developmentally appropriate conditioning training program on agility and anaerobic endurance of high school football players in Kerala. The results indicate that indeed, structured, specific conditioning will lead to substantial gains in these two critical aspects of football performance. These findings are strongly supported by evidence in this study.

Agility, which supports rapid changes of direction and fast-paced reaction to ever-changing contexts of a match, significantly improved for the experimental group.

In summary the study shows that a well-planned training can improve agility and anaerobic endurance in players. This

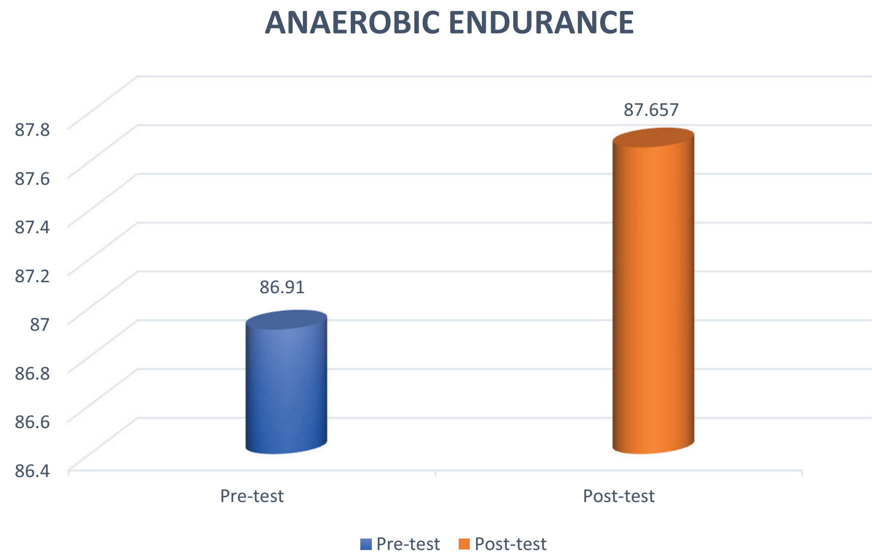

FIGURE 8 | Pre- and post-test anaerobic endurance of control group.

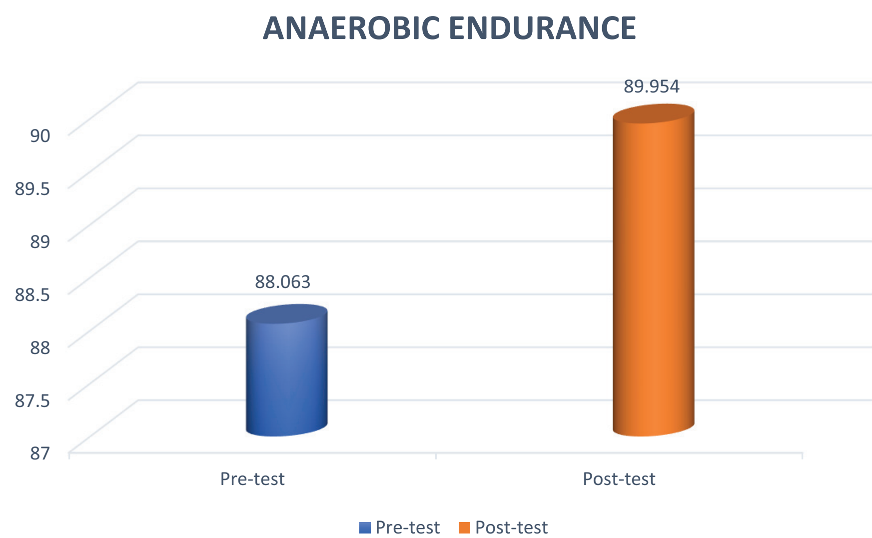

FIGURE 9 | Pre- and post-test anaerobic endurance of experimental group.

shows the importance of scientific training methods in young football players to develop their skills.

Ethics statement

This study has followed all relevant institutional and national guidelines and has been approved by the institutional and national research ethics committees before commencing the study.

Author contributions

ATP, JA: Participant training, Data curation. A: Formal analysis, Data interpretation, Writing – review & editing. All authors reviewed and approved the final version of the manuscript.

Funding

No specific grant has been received from any funding agency in the public, commercial, or not-for-profit sectors for this research.

Acknowledgments

We are deeply thankful to every person and institution that contributed to the completion and success of this work. A special thanks to Anand TP and Jejijohn Abraham for all your devoted work towards the training and data collection, and to Alwin Mathew T for his useful inputs in the finalization of the statistical analysis and continual support and insight throughout the project.

Informed consent

Informed consent has been obtained from all individual participants included in the study.

Additional materials

The more detailed approval for the supplementary materials related to this research can be requested from the corresponding author.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

References

1. Azmi K, Kusnanik NW. Effect of exercise program speed, agility, and quickness (SAQ) in improving speed, agility, and acceleration. *J Phys Conf Ser.* (2018) 947:1–6. doi: 10.1088/1742-6596/947/1/012043
2. Beato M, Bianchi M, Coratella G, Merlini M, Drust B. Effects of plyometric and directional training on speed and jump performance in elite youth soccer players. *J Strength Condit Res.* (2019) 33(12):3378–85. doi: 10.1519/JSC.0000000000003362
3. Brito J, Vasconcellos F, Oliveira J, Krustrup P, Rebelo A. Short-term effects of combined resistance and running training on body composition, neuromuscular performance and aerobic fitness in soccer players. *Eur J Sport Sci.* (2020) 20(5):607–16. doi: 10.1080/17461391.2019.1702578
4. Clemente FM, Ramirez-Campillo R, Castillo D, Raya-González J, Afonso J. Effects of plyometric training in male youth soccer players: a systematic review. *Sports.* (2021) 9(2):28. doi: 10.3390/sports9020028
5. Doganay M, Bingui M, Bergun M, Garcia CA. Effect of core training on speed, quickness and agility in young male football players. *J Sports Med Phys Fit.* (2020) 60(9):1240–6. doi: 10.23736/S0022-4707.20.10544-9
6. Ghosh SS, Biswas R. Comparison of resistance training and plyometric training for the development of speed of the athletes. *Senhri J Multidiscip Stud.* (2020) 5(1):59–71. doi: 10.36110/sjms.2020.05.01.007
7. Hammami A, Gaamouri N, Aloui G, Shephard RJ, Chelly MS. Effects of combined plyometric and short sprint training on physical performance in U19 soccer players. *Front Physiol.* (2019) 10:1036. doi: 10.3389/fphys.2019.01036
8. Hernandez D, Ramirez-Campillo R, Sanchez-Sanchez J. Effects of plyometric training on maximal-intensity exercise and endurance in male soccer players. *J Hum Kinet.* (2018) 62:33–45. doi: 10.1515/hukin-2017-0191
9. Koral J, Oranchuk DJ, Herrera R, Millet GY. Six sessions of sprint interval training improves running performance in trained athletes. *J Strength Condit Res.* (2018) 32(3):617–23. doi: 10.1519/JSC.0000000000001940
10. Lesinski M, Prieske O, Granacher U. Effects and dose–response relationships of resistance training on physical performance in youth athletes: a systematic review and meta-analysis. *Br J Sports Med.* (2018) 50(13):781–95. doi: 10.1136/bjsports-2015-095497
11. Loturco I, Pereira LA, Reis VP, Zanetti V, Bishop C, Nimphius S. Change-of-direction performance in elite soccer players: effects of age and positional role. *Int J Sports Physiol Perform.* (2019) 14(7):1003–10. doi: 10.1123/ijspp.2018-0583
12. Monks L, Seo MW, Kim HB, Jung HC, Song JK. High-intensity interval training and athletic performance in soccer players: a systematic review. *J Sports Sci Med.* (2021) 20(3):413–25. doi: 10.52082/jssm.2021.413
13. Oliveira R, Brito J, Martins A, Mendes B, Rebelo A. In-season running performance variations among professional soccer players: a systematic review. *Sports.* (2020) 8(1):5. doi: 10.3390/sports8010005
14. Pereira LA, Freitas TT, Pupo JD, Andrade VL, Loturco I, Bishop C. Relationship between change of direction, speed, and power in male and female national soccer players. *J Sports Sci.* (2019) 37(3):277–85. doi: 10.1080/02640414.2018.1493024
15. Pricop A, Florescu O, Pelin R, Grigoroiu C, Braneţ C. Study on improving the physical fitness level of young football players. *Revista Românească pentru Educaţie Multidimensională.* (2022) 14(4):506–23. doi: 10.18662/rrem/14.4/523
16. Rahman M, Islam M. Investigation of audio-visual simple reaction time of university athletes and non-athletes. *J Adv Sports Phys Educ.* (2021) 4(3):100–4. doi: 10.36348/jaspe.2021.v04i03.002
17. Ramirez-Campillo R, Gentil P, Negra Y, Clemente FM. Effects of plyometric training on physical performance of young soccer players: a systematic review and meta-analysis. *Front Physiol.* (2019) 10:1152. doi: 10.3389/fphys.2019.01152
18. Raya-González J, Suarez-Arrones L, Bishop C, Clemente FM. Strength and conditioning in soccer: a bibliometric analysis. *Biol Sport.* (2021) 38(4):497–506. doi: 10.5114/biolsport.2021.104207
19. Rodriguez-Fernandez A, ánchez-Sánchez JS, Ramirez-Campillo R, Nakamura FY, Villa JG. Effects of different small-sided games on physical fitness and physiological responses in young soccer players. *Sports.* (2019) 7(3):68. doi: 10.3390/sports7030068
20. Slimani M, Nikolaidis PT. Anthropometric and physiological characteristics of male soccer players according to their competitive level, playing position and age group: a systematic review. *J Sports Med Phys Fit.* (2019) 59(1):141–63. doi: 10.23736/S0022-4707.18.08696-0
21. Stojanović E, Ristić V, McMaster DT, Milanović Z. Effect of plyometric training on vertical jump performance in female athletes: a systematic review and meta-analysis. *Sports Med.* (2018) 47(5)):975–86. doi: 10.1007/s40279-017-0852-0
22. Van de Hoef PA, Brauers JJ, van Smeden M, Backx FJ, Brink MS. The effects of lower extremity strength training on change of direction speed performance in soccer players: a systematic review and meta-analysis. *Sports Med.* (2019) 49(12):1889–901. doi: 10.1007/s40279-019-01171-2
23. Yanci J, Los Arcos A, Grande I, Casajús JA, Campo RL. Effects of small-sided games vs. interval training in soccer players: a systematic review and meta-analysis. *Sports.* (2019) 7(3):87. doi: 10.3390/sports7030087
24. Zhang Y, Wang X, Guo M. The effect of after-school football programs on children's physical fitness. *Int J Phys Act Health.* (2022) 1(2):1–14. doi: 10.18122/ijpah.1.2.14.boisestate
25. Vassil A, Bazanov A. Effect of plyometric training on motor abilities of volleyball players. *J Phys Educ Sport.* (2018) 18(2):789–94. doi: 10.7752/jpes.2018.02115.