Scholar's Digest- Journal of Multidisciplinary Studies
Volume 3, Issue 10, October - 2024
ISSN (E): 2949-8856
Scholarsdigest.org

THE EFFECT OF CROSSFIT EXERCISES ON THE MAXIMUM ANAEROBIC CAPACITY OF YOUNG FOOTBALL PLAYERS

Asst. Prof. Dr. Abdullah Mohammed Tayawi
College of Physical Education and Sports Sciences, University of Tikrit, Iraq
Email: dr.t.ay1970@tu.edu.iq

Dr. Adnan Mohammed Shanawa
General Directorate of Education in Salahuddin Governorate, Ministry of Education, Iraq
Email: Adnan.m.shnawa@tu.edu.iq

Abstract
The study aimed to explore the effect of CrossFit training on the maximum anaerobic capacity of young football players. Specifically, it sought to:
1. Assess the results of the pre- and post-tests of maximum anaerobic capacity for the experimental and control groups.
2. Compare the differences in the post-test results of maximum anaerobic capacity between the two groups.
The most important conclusions indicate that competitive exercises combined with CrossFit training, implemented through high-intensity interval training, had a positive impact on the maximum anaerobic capacity of young football players. Furthermore, CrossFit training using high-intensity intervals positively influenced the research variable among these players.
The research population and sample were selected from the Al-Alam Football Club, which participated in the first youth league for the 2021-2022 season. The number of registered players, according to the Salahuddin Football Association, was thirty-two. After conducting medical examinations, including echocardiograms (Echo) to ensure the cardiac fitness of the players, and clinical tests by a specialist in cardiology and internal medicine to confirm their health status, the researchers divided the sample into two groups (experimental and control). The division was done by matching players based on their measurements, capabilities, and positions, as much as possible, and a lottery was conducted. Each group consisted of twelve players, after excluding eight players (3 goalkeepers, one player with mitral valve prolapses as advised by the doctor, and four players due to injuries or irregular attendance in training).

Keywords: CrossFit, maximum anaerobic capacity, youth stage.

Introduction

1-1 Introduction and Importance of the Study:

Football relies on a wide variety of skills and movements. To enhance and develop these skills, a solid and diverse physical foundation is required, one that aligns with the nature and movement patterns of the game. This foundation should also correspond with the physical characteristics of the athlete, as well as the functions and development of vital body systems when performing physical effort. Such effort must be in harmony with the body's energy

production systems to manage fatigue, promote quick recovery, and support overall performance.

Understanding these variables, alongside other essential factors such as player talent, early identification, proper selection, care, and development, is crucial to achieving elevated levels of performance and sports success. This progression should also consider the athlete's age group, performance demands, and competition requirements until they reach advanced levels of play.

Given the demands of maintaining performance under high physical exertion during matches, the researchers proposed integrating **CrossFit** exercises into the training regimen. CrossFit involves continuous and varied physical efforts, a crucial component in its training, providing a motivating factor for sustained performance. Such training contributes to the development of physical fitness and can provide precise indicators on the benefits and suitability of the training in relation to the player's abilities. This is especially true when CrossFit is used to enhance competitive performance or both general and specific fitness, ensuring players are well-prepared to execute game strategies and responsibilities.

Maximum anaerobic capacity is an indicator of an athlete's ability to perform at high intensities for extended periods during matches, delaying the onset of fatigue. The volume of work performed during this capacity, along with rapid recovery after intense physical exertion, serves as a real measure of progress in training and the necessary adaptations in the vital systems and organs of the player's body.

Thus, the importance of this research lies in designing **CrossFit** exercises tailored to the age group of the players, the nature of the game, and the effective energy systems. The exercises should also consider the type and size of the working muscles, the intensity and volume of exertion, the training period, and the proximity and significance of the competition. This aligns with what **Laith Ibrahim Al-Ghariri (2010)** emphasized: training programs must be tailored to the specific movement patterns and intensity of the sport, focusing on the dominant physical traits required for performance, and emphasizing the muscles actively engaged in the sport. Training should even include movements and exercises like those in the competition, as specialized training leads to specific adaptations in response to the physical demands placed on the body's systems[1].

1-2 Research Problem:

Through their experience as players, coaches, and academics in football training for various age groups, and by closely monitoring Al-Alam Football Club's participation in the Salahuddin Youth League during the 2021-2022 season, the researchers observed a decline in performance. This included frequent mistakes in basic skills such as incorrect passes, unsuccessful dribbling, poor decision-making regarding ball control, and improper positioning to occupy space. These issues were particularly evident in the final third of the match, where players struggled to maintain superior performance for extended periods.

[1] Laith Ibrahim Jassim Al-Ghariri; Sports Training: Methodological Fundamentals: (Ministry of Higher Education, University of Diyala / College of Physical Education, 2010), p. 39.

The researchers attributed this decline to the functional deterioration of the body's active systems during performance, due to a decrease in physical fitness that is crucial for executing these skills. This, in turn, negatively affected the effectiveness and quality of performance during matches.

To address this issue, the researchers developed a **CrossFit** training program, considering the specific demands of the game and energy systems used during competition. The exercises were designed to meet the players' physical needs and abilities while ensuring that each player could execute the required strategies and responsibilities during matches. These exercises focused on enhancing physical strength at a specific intensity under continuous physical exertion.

The researchers posed the following question: **Does CrossFit training have an impact on the maximum anaerobic capacity of young football players?** They hoped to answer this question in service of both sports' science and the football community.

1-3 Research Objectives:

- To explore the effect of **CrossFit** training on the maximum anaerobic capacity of young football players.
- To evaluate the results of the pre- and post-tests of maximum anaerobic capacity for the experimental and control groups.
- To compare the differences in post-test results of maximum anaerobic capacity between the experimental and control groups.

1-4 Research Hypotheses:

- There will be statistically significant differences between the pre- and post-test results of maximum anaerobic capacity for the experimental and control groups.
- There will be statistically significant differences between the post-test results of maximum anaerobic capacity for the experimental and control groups, in favor of the experimental group.

1-5 Research Fields:

- **Time Frame**: From January 8, 2022, to April 1, 2022.
- **Location**: Al-Alam Sports Club Stadium.
- **Human Field**: Young football players of Al-Alam Football Club during the 2021-2022 season.

1-6 Definition of Terms:

- **CrossFit Training**: Strength training characterized by speed, appropriate intensity, and continuous physical exertion, targeting different and successive muscle groups.

- **2. Research Methodology and Field Procedures:**
- **2-1 Research Methodology:**
- The researchers adopted the experimental method as it suited the nature and problem of the research.
-
- **2-2 Research Population and Sample:**
- The research sample was purposefully selected from Al-Alam Football Club, which participated in the first youth league for the 2021-2022 season. According to the Salahuddin Football Association, thirty-two players were registered. The players underwent medical examinations, including echocardiograms (Echo), to ensure their heart health, as well as clinical examinations conducted by a specialist in cardiology and internal medicine to confirm their health readiness for the experiment. Following **Baha Al-Din Ibrahim Salama's (2009)** recommendation to conduct medical checks before beginning a training program, the researchers divided the sample into two groups (experimental and control) using the pairing method based on player measurements, abilities, or playing positions. Players were then assigned by lottery. Eight players were excluded from the sample: three goalkeepers, one player with mitral valve prolapse (excluded per medical advice), and four players due to injuries or irregular training attendance.

2-3 Selection of Tests for the Research Variable in Young Football Players:

After conducting a comprehensive review and analysis of credible scientific sources and references, the **RAST test** was nominated and presented during personal interviews with experts and specialists.

1. **Anaerobic Capacity Test (RAST Test)**[2]

Test Objective: To measure maximum anaerobic capacity.

Required Equipment: A field, four stopwatches, an electronic scale, two whistles for starting signals, and an electronic pulse monitor.

Test Description: The test consists of six fast sprints over thirty-five meters, which the participant completes consecutively, with a 10-second rest between each sprint.

Scoring Method: The time to cover each 35-meter sprint is recorded in seconds and hundredths of a second. The anaerobic power for each repetition is calculated as follows:

- **Anaerobic Power (in watts)** = (weight × distance²) / time³.
- **Average Anaerobic Power (in watts)** = sum of values / 6.

2-4 Data Collection Methods:

The researchers used the following methods to collect data:

- Content analysis
- Questionnaire
- Personal interviews

[2] Abdullah Mohammed Tayawi: The Effect of Play Exercises on Anaerobic Capacity and Some Basic Skills of Youth Football Players Under 19 Years: (master's Thesis, University of Tikrit / College of Physical Education, 2010), p. 45.

- Measurements and tests
  The measurements taken for the sample included:
- Total body height
- Body mass
- Age

2-5 Homogeneity and Equality of the Research Groups:

2-5-1 Homogeneity of the Research Groups:

The researchers ensured the homogeneity of the experimental and control groups by considering variables such as age, training age, height, and body mass, as presented in Table 3.

Table (3): If the skewness coefficient values range between ±1.

Variables	Unit of Measurement	Mean	Standard Deviation	Mode	Skewness Coefficient
Age	Years	17.86	0.470	17.5	0.765
Training Age	Years	4.52	0.635	4	0.818
Height	cm	172.245	5.372	172	0.045
Body Mass	kg	64.12	4.459	64	0.026

3-5-2 Equivalence of the Research Groups:

The researchers conducted an equivalence check between the experimental and control groups in the variable under study, as shown in **Table (4)**.

Statistics / Variables	Unit	Control group		Experimental group		(T) Value	Sig	SIG
		M	SD	M	SD			
Maximum Anaerobic Capacity	**Watt**	**382,654**	**26,203**	**396.274**	**20,861**	**1,217-**	**0,249**	Not significant

Significant at a probability level of > (0.05)

Table (4): There are no statistically significant differences between the pre-test results for the control and experimental groups, as the calculated value of (t) was (-1.217) and the value of (sig) was (0.249) for the performance variable, which is greater than the value of (0.05).

3-8 Field Procedures Used in the Research:

3-8-1 Points on Which CrossFit Exercises Were Developed:

- Consideration of the training period during which the exercises were applied, specifically the special preparation period and pre-competition phase.
- Design of CrossFit exercises using common exercises to develop muscular strength and using body weight.
- Utilization of CrossFit exercises taken from moderate intensity (80% and 85%) of the maximum the player can achieve.
- Consideration of the nature and community of the research sample.

3-8-2 Determining Times and Number of Repetitions for Each Exercise:

- This procedure was executed on the second exploratory sample, which consisted of the experimental group players (12 players) to determine the time and number of repetitions for each exercise used in the research.

3-8-3 Determining Approved Rest Periods Between Repetitions and Sets:

- Rest periods were determined between each repetition in the form of a set of exercises, with incomplete rest allowed until the heart rate returned to (120-130) beats per minute for CrossFit exercises, according to the exploratory trial.

2-10 Final Procedures for the Research:

2-10-1 Conducting Pre-tests for Maximum Anaerobic Capacity:

- Pre-tests for the variable under investigation were conducted on Monday (31/1/2022).

2-10-2 Applying CrossFit Exercises:

- The training program for CrossFit exercises commenced on Saturday (5/2/2022) and concluded on Wednesday (30/3/2022) with the completion of all specific units for the experimental group, coinciding with the training curriculum prepared by the coach and applied to the control group. The following points were considered when implementing these exercises:
  - Starting the training unit with general warm-up for all players, followed by specific warm-up.
  - Executing CrossFit exercises at the end of the main part of the training unit.
  - The number of training units was (3) units per week for a duration of (8) consecutive weeks.
  - The load wave was (1-3) in the intermediate cycle.
  - Utilizing high-intensity interval training in determining rest periods between repetitions, sets, and exercises.
  - Controlling the load intensity by increasing exercise duration.
  - Increasing the duration of CrossFit exercises, using intensities of (80%, 85%) while stabilizing the number of repetitions and sets, and applying rest periods between sets at (2:1), fixed at (3) minutes between main exercises, according to the high-intensity interval training method.

2-10-3 Conducting Post-tests:

After completing the exercises prepared for the experimental group, which are CrossFit exercises, and the specific training for the control group prepared by the coach, post-tests for both groups (experimental and control) were conducted, specifically the maximum anaerobic capacity tests for young football players, following the same methods used in the pre-tests on Thursday (31/3/2022).

2-11 Statistical Methods:

The data were statistically processed using the SPSS statistical system.

3- Presentation, Analysis, and Discussion of Results:

3-1 Presentation and Analysis of the Pre- and Post-Test Results for the Control and Experimental Groups for the Variable Under Investigation:

3-1-1 Presentation and Analysis of the Pre- and Post-Test Results for the Control Group for Maximum Anaerobic Capacity:

(Table 6)

Statistics Variables	Unit	Control - Pre		Experimental - Post		(T) Value	Sig	SIG
		M	SD	M	SD			
Maximum Anaerobic Capacity	Watt	396,27	20,86	457,86	29,95	11,284-	0,000	significant

(*) Significant if the value of (sig) is greater than (0.05).

Table (6) shows that there are statistically significant differences between the pre-test results of the control group for maximum anaerobic capacity, as the calculated value of (t) was (-3.65), and the value of (sig) was (0.004), which is less than (0.05).

Statistics Variables	Unit	Control - Pre		Experimental - Post		(T) Value	Sig	SIG
		M	SD	M	SD			
Maximum Anaerobic Capacity	Watt	382,65	26,20	417,48	31,48	3,65-	0,004	significant

Table (7) shows:

- There are statistically significant differences between the results of the pre- and post-tests of the experimental group in maximum anaerobic capacity, as the calculated t value was (-11.284), and the value of (sig) was (0.000), which is less than (0.05).

Discussion of the Differences Between the Pre- and Post-Tests of the Experimental Group in Maximum Anaerobic Capacity

Table (7) shows:

- There are statistically significant differences between the results of the pre- and post-tests of the experimental group in maximum anaerobic capacity.

The researchers explain the development in maximum anaerobic capacity by stating that the CrossFit exercises were appropriate for the research sample and the age group of the players. They took care to ensure that the training methods reflected what occurs in a match. These exercises allowed the players to adapt and improve their physical fitness, which is crucial for football players. This is supported by Khalid Jamal Al-Sayed (2016), who stated, "The physical condition of football players is one of the essential foundations that determine the effectiveness of technical and tactical performance."[3]

[3] Khalid Jamal Al-Sayed; "Loads in Football," 1st Edition: (Alexandria, Scientific Sports Publishing House and Dar Al-Wafa for Printing, 2016), p. 9.

The diversity in speed, strength, and performance levels through the determination of player movements and responsibilities during gameplay, according to the actual demands of the game, has contributed to this development. This is aligned with the needs of football players concerning maximum anaerobic capacity and the evolving specific requirements of the game. Hashim Yasser Hassan (2011) states that "the performance of a football player in high-intensity and intermittent physical and skill movements leads to an increased percentage of oxygen used in the muscles, which helps in energy production. Implementing this approach during training sessions assists players in performing their duties effectively."[4]

CrossFit exercises compensate for the deficiency in muscular strength and add a high load on the muscular, nervous, and cardiovascular systems. They are also performed in a competitive manner among teammates or against oneself. The increasing popularity of CrossFit has drawn researchers' attention to implementing this approach. These exercises include weightlifting, strength training, and functional training, with a focus on continuous improvement of athletic performance during individual workouts through competition with training partners or self-competition in this strength model. Training can also be adapted according to the player's environment[5].Jamal Sabri Farag (2019) adds that a deficiency in general and specific muscular strength not only affects physical performance but also has a high likelihood of causing technical or tactical errors. Additionally, increased fatigue impacts attention, mental alertness, and reaction times. To address this issue, training should focus on enhancing all existing aspects of muscular strength and cardiovascular fitness, as well as developing the muscles' ability to handle powerful or explosive contractions. It is also important to train the ligaments and tendons, as well as the muscle-tendon unit, to store and release energy when needed.[6]

One of the principles considered in applying the exercises was the principle of progression in training load for CrossFit exercises. The number of exercises in each repetition was increased while keeping the duration of each exercise fixed at 10 seconds during the first intermediate cycle. In the second intermediate cycle, the duration of exercises in each repetition was increased to 15 seconds, along with an increase in the number of exercises according to the requirements of this type of training. Mehmet Söyler and İdris Kayantaş point out that CrossFit exercises are performed quickly, with repetitive movements and little or no rest between sets.[7] This was confirmed by the results of the post-test for the experimental group. Bahaa Eldin Ibrahim Salama (two thousand) adds that "the principle of progression in training load should be implemented in a sequential manner and over time periods that allow the vital systems to adapt to these loads. The heart rate is used to determine the progression of the training load and to ensure that adaptation to physical loads occurs."[8]

[4] Hashim Yasser Hassan; *Performance Endurance for Football Players*: (Baghdad, Arab Community Library for Publishing and Distribution, 2010), p. 22.
[5] Tadeusz Ambroży (et , al), Effect of Cross Fit Training on Physical Fitness of Kickboxers : (Int. J. Environ. Res. Public Health 2022, 19, 4526)p1
[6] Jamal Sabri Farag; *Encyclopedia of Endurance and Stamina – Training – Physiology – Performance*, Vol. 2, 1st Edition: (Amman, Jordan, Dar Safa for Publishing and Distribution, 2019), p. 164.
[7] Mehmet SÖYLER, İdris KAYANTAŞ , Effects of Cross-Fit Trainings on Body Composition and Some Physical Parameters in Sedentary Men:(International Journal of Sport Culture and Science December 2020)p265.
[8] Bahaa Eldin Ibrahim Salama (two thousand); *Previous Source*, p. 288.

Statistics / Variables	Unit	Control – Pre		Experimental - Post		(T) Value	Sig	SIG
		M	SD	M	SD			
Maximum Anaerobic Capacity	**Watt**	**417,48**	**31,48**	**457.86**	**29,95**	**-2,909**	**0,014**	significant

(*) Significant if the value of (sig) > (0.05)

Table (8):

- There are significant differences between the results of the post-tests for the control and experimental groups in performance endurance, with the calculated value of (t) being (-2.909) and the value of (sig) being (0.014), which is less than (0.05).

3-2-2 Discussion of the Results of Differences Between the Post-Tests for the Control and Experimental Groups in Maximum Anaerobic Capacity:

- **Table (8)** shows that there are significant differences between the results of the post-tests for the control and experimental groups in maximum anaerobic capacity, favoring the post-test of the experimental group.
- The researchers attribute the existence of these differences in maximum anaerobic capacity in favor of the experimental group to achieving the appropriate training effect and its reflection on the development of the vital organs and special abilities of the players, compared to the control group, which underwent the training program prepared by the coach. The competitive exercises prepared by the researchers are based on scientific foundations and modern training theories, considering the time, repetitions, intensity, and density of exercises, as well as the intervals for rest in a manner consistent with the abilities, capacities, and age of the experimental group members. The researchers also emphasized the need for progression in the intensity, volume, and difficulty of exercises within the framework of achieving the necessary development and functional adaptation throughout the training units and micro-cycles over a period of eight training weeks. This is supported by Abdul Rahman Abdel Hamid Zaher (2020), who stated, "Regulating training loads in accordance with the physiological capacity of the athlete is one of the most important factors for the success of the training program and subsequently improving performance. The training load is the means to create physiological effects on the body, leading to improved responses and adaptations of its systems."[9] Abu Al-Ala Ahmed Abdel Fattah (1994) adds that "in order to achieve true and effective physiological adaptations, training must be organized, regular, and continuous for a period of no less than (8-12) weeks."[10]

  Risan Khraibit, Mohammed Abdel Zaher (2022) stated, "Creating a balance between the three factors (training stress, competition, and recovery) is one of the essential pillars in achieving maximum athletic readiness. Therefore, it is the coach's responsibility to assess the

[9] Abdul Rahman Abdel Hamid Zaher; Strategies for Training Athletics: (Cairo - Nasr City, Dar Al-Kitab Publishing Center, 2020), p. 113.
[10] Abu Al-Ala Ahmed Abdel Fattah; Swimming Training for Advanced Levels, 1st ed.: (Cairo, Dar Al-Fikr Al-Arabi, 1994), p. 242.

athlete's performance level in training and competition and the level of fatigue that can be reached."[11]

Including competition exercises using small games with limited areas and a specific number of players benefits the performance of football players by allowing them to train in an environment that simulates real competition. These exercises are carried out in an appropriate training manner, with incomplete rest periods, and are combined with CrossFit exercises, which include strength training performed at a certain speed. The scientific principles and rules of sports training are considered.

Majid Ali Mousa Al-Tamimi (2009) states that the development of speed-strength increases as training approaches the competition phase in events where speed-strength is one of the essential factors for achieving results. This applies to events such as throwing in athletics, sprinting, and short-distance swimming. The closer speed-strength reaches the correct development stage, the greater the work done in the least amount of time, allowing for a higher number of repetitions of the exercise at maximum speed. The number of repetitions should not increase to the extent that it shifts the training goal from speed-strength to strength endurance.

One important aspect to consider is the presence of speed in movement performance to develop speed-strength. In resistance training, the maximum speed and resistance weight should exceed 80-90% of the athlete's maximum capacity in the specific exercise.[12]

Through the repetition of exercise times and performing them in a competitive style, it is noted that at the beginning of any muscular work, according to scientific sources and references, it relies on the phosphagen system to produce the necessary energy for performance. The re-storage of phosphagen energy sources occurs quickly and is linked to the rapid return of the pulse to its natural state during the recovery period. The energy that the body needs for the re-storage of ATP is primarily derived from the oxygen system during rest. High training loads achieve the functional capacity development of the circulatory system due to its role in transporting oxygen to the tissues. When the phosphagen system is depleted, the body resorts to the second lactate system to produce the energy necessary for the continuation of work and the restoration of this system. This is confirmed by Ali Fahmy Al-Baik and others (2009), who state that at the beginning of muscular work, the phosphagen system within the muscles provides rapid anaerobic energy for muscle movement. After the initial seconds of movement, the glycolytic energy system (anaerobic glycolysis) provides energy, which requires rest periods for aerobic metabolic pathways to reconstitute ATP.[13]

Raysan Kharibit and Mohamed Mahmoud Abdel Zaher (2022) confirm that during maximum performance for durations ranging from 10 to 60 seconds, reliance on anaerobic energy production processes accounts for over 70% of energy contribution. However, when maximum performance extends to 3 minutes, it is observed that approximately 60% of ATP

[11] Risan Khraibit, Mohammed Mahmoud Abdel Zaher (2022); Source previously mentioned, pp. 306-307.

[12] Majid Ali Mousa Al-Tamimi; *Modern Sports Training*, first edition: (Baghdad, Al-Nakheel Printing Press, 2009) p. 102-103.

[13] Ali Fahmy Al-Baik (et al.) (2009), 1st Edition, "Methods and Techniques of Training for Developing Anaerobic and Aerobic Capacities," (Alexandria, Manasat Al-Maarif), p. 77.

generation occurs through aerobic processes.[14] Bahaa El-Din Ibrahim Salama (2000) adds that "the physiological preparation of a football player aims to direct training programs towards developing anaerobic fitness, enabling the player to perform his technical duties efficiently without experiencing early fatigue due to a lack of oxygen during performance. The body's systems must also be capable of quickly addressing this deficit during periods of reduced play. Training units and their objectives should be organized to enhance and improve anaerobic energy release systems in line with the nature of modern football performance."[15] Ben Reuter emphasizes that each of the energy systems operates continuously during exercise, but they function at various levels of ATP production depending on the intensity and duration of the activity.[16]

This interconnection between the components of competitive exercises, in terms of their organization and the ease and fluidity of their execution, considers their diversity and the addition of elements of excitement and thrill when performed by groups of two, three, four, etc. Players can experience varying levels of difficulty through adjusting exercise duration, assigning specific responsibilities, or limiting touches on the ball. Coupled with CrossFit exercises, players exert high physical effort by combining strength with speed, transitioning from one exercise to another, and targeting different muscle groups without taking breaks, except for the time needed to change body positions. This leads to the adaptation and development of the body's vital systems to meet the specific performance demands of the game.

The CrossFit program is unique in its goals, recipes, methodologies, and implementation, preparing trainees optimally for any physical emergencies. The essence of CrossFit exercises lies in their high intensity, constantly varied functional movements, which are among the most critical aspects of functional movements due to their ability to produce high energy and move heavy loads over long distances quickly[17].

Based on the previous discussion, using competitive play exercises with specific parameters established during the training program's design—such as determining the number of players, the size of the field, the allowed number of touches per player, and the challenge of winning or losing—immerses players in a competitive environment. This setting demands high physical, mental, and cognitive effort, along with intense concentration from players to execute their required tasks without making mistakes that could lead to losing possession of the ball, missing scoring opportunities, or losing the game.

Additionally, incorporating CrossFit exercises alongside competitive drills helps compensate for any deficiencies in overall muscular strength while maintaining and developing speed-endurance that aligns with competition performance demands. This approach was particularly effective as the training program was implemented during the specific preparation phase and the initial stages before competition. The clear outcomes from the researchers' findings and the comparisons of pre-experimental tests with the post-

[14] Raysan Kharibit, Mohamed Mahmoud Abdel Zaher (2022); Source previously mentioned, pp. 392-393.
[15] Bahaa El-Din Ibrahim Salama (two thousand); previously mentioned source, p. 282.
[16] Ben Reuter, editor ; Developing endurance / National Strength and Conditioning Association (NSCA) : (Library of Congress , National Strength and Conditioning Association,2012) p6 .
[17] Greg Glassman , Understanding Cross Fit : (Published in CrossFit Journal Issue 56 - April 2007)p1.

experimental results between the control and experimental groups support the development and sustainability of gameplay, especially during crucial moments at the end of competitive matches.

As noted by Alvin George Cobar and Norberto Madrigal, monitoring athletes' endurance capabilities during training is essential for achieving optimal performance goals. It predicts endurance levels and the quality of performance execution, particularly at the end of each match when players exert their final efforts to secure victory. Consequently, adaptation occurs over months of training to enhance the appropriate energy systems, cellular activity, and muscle oxidation.[18]

Conclusions and Recommendations

5-1 Conclusions:

- The combination of competitive exercises with CrossFit training using high-intensity interval training has positively impacted the maximum anaerobic capacity of youth football players.
- Merging competitive exercises with CrossFit in a high-intensity interval training approach has significantly influenced the maximum anaerobic capacity variable among young football players.

5-2 Recommendations:

- Emphasize the use of synchronized competitive exercises alongside CrossFit training using high-intensity interval training for youth football players.
- Implement competitive exercises in a reciprocal training style with CrossFit exercises.
- Conduct studies on the use of synchronized competitive exercises with CrossFit training using other training methods.
- Utilize CrossFit exercises with additional external resistance or by incorporating equipment and tools within the training field.
- Carry out studies on the application of synchronized competitive exercises with CrossFit for different age groups.

References

1. Abu Al-Ala Ahmad Abdel Fattah. *Training for High-Level Swimming*, 1st ed. (Cairo: Dar Al-Fikr Al-Arabi, 1994).
2. Bahaa El-Din Ibrahim Salama. *Physiology of Sports and Physical Performance* (Cairo: Dar Al-Fikr Al-Arabi, 2000), p. 287.
3. Jamal Sabri Farag. *Encyclopedia of Endurance and Stamina – Training – Physiology – Achievement*, Vol. 2, 1st ed. (Amman, Jordan: Dar Safa for Publishing and Distribution, 2019).
4. Khaled Jamal Al-Sayed. *Training Loads in Football*, 1st ed. (Alexandria: Sports Science Publishing House and Dar Al-Wafa for Printing, 2016).

[18] ALVIN GEORGE C. COBAR, NORBERTO MADRIGAL , Effect of endurance training with weighted vest on the 3000-meter running time of high school boys : (Journal of Physical Education and Sport,2016)p301.

5. Risan Khraibet and Mohamed Mahmoud Abdel Zaher. (2022). *Source Previously Mentioned*, pp. 306-307.
6. Abdel Rahman Abdel Hamid Zaher. *Strategies for Training in Track and Field* (Cairo - Nasr City: Book Center for Publishing, 2020).
7. Abdullah Mohammed Tiyawi. "The Effect of Play Exercises on Anaerobic Capacity and Some Basic Skills of Youth Football Players Under 19 Years Old" (master's Thesis, University of Tikrit / College of Physical Education, 2010).
8. Ali Fahmy Al-Bayek et al. *Methods and Techniques of Training to Develop Anaerobic and Aerobic Capacities*, 1st ed. (Alexandria: Manasat Al-Ma'arif, 2009).
9. Laith Ibrahim Jassem Al-Ghareeri. *Sports Training Methodology Basics* (Ministry of Higher Education, University of Diyala / College of Physical Education, 2010).
10. Majid Ali Mousa Al-Tamimi. *Modern Sports Training*, 1st ed. (Baghdad: Al-Nakheel Press, 2009).
11. Hashim Yasser Hassan. *Performance Endurance for Football Players* (Baghdad: Library of the Arab Publishing and Distribution Complex, 2010).
12. Alvin George C. Cobar and Norberto Madrigal. "Effect of Endurance Training with Weighted Vest on the 3000 Meter Running Time of High School Boys," *Journal of Physical Education and Sport*, 2016.
13. Ben Reuter, ed. *Developing Endurance*, National Strength and Conditioning Association (NSCA) (Library of Congress: National Strength and Conditioning Association, 2012).
14. Greg Glassman. "Understanding CrossFit," published in *CrossFit Journal*, Issue 56 - April 2007.
15. Mehmet Söyler and İdris Kayantaş. "Effects of CrossFit Training on Body Composition and Some Physical Parameters in Sedentary Men," *International Journal of Sport Culture and Science*, December 2020.
16. Tadeusz Ambroży et al. "Effect of CrossFit Training on Physical Fitness of Kickboxers," *International Journal of Environmental Research and Public Health*, 2022, 19, 4526.
17. Tadeusz Ambroży et al. "Effect of CrossFit Training on Physical Fitness of Kickboxers," *International Journal of Environmental Research and Public Health*, 2022, 19, 4526.

Appendix (1): Model for Implementing CrossFit Exercises

Day	CrossFit Exercises	Exercise	Seconds	Intensity	Repetitions	Rest Between Reps (seconds)	Sets	Rest Between Sets (seconds)	Rest Between Exercises (seconds)	Work Time (seconds)	Total Training Time (minutes)
Saturday	Exercise one	T1	20	80%	2	20	3	60	180	480	16
	Exercise two	T2	20	80%	2	20	3	60	180	480	
Monday	Exercise three	T6	20	80%	2	20	3	60	180	480	16
	Exercise four	T9	20	80%	2	20	3	60	180	480	
Wednesday	Exercise five	T7	20	80%	2	20	3	60	180	480	16
	Exercise six	T8	20	80%	2	20	3	60	180	480	

Muscle Strength Exercises Used in CrossFit Training Units:

1. **Abdominal Exercise**: From a lying position on the back with knees bent, perform sit-ups.
2. **Standing Position**: Jumping jack with a half-squat.
3. **Back Exercise**: From a prone position, lift and lower the arms along with the torso.
4. **Hopping**: Hop on the right foot for ten meters and return on the left foot for the same distance; in the second intermediate round, perform for fifteen meters.
5. **Front Support**: Pull the knees to the chest, extend them, then stand up and return to the front support position.
6. **Lying Position**: With arms on the ground beside the body, flex and extend the legs.
7. **Jumping Forward and Backward**: Continuous jumping with both feet.
8. **Jumping Side to Side**: Continuous jumping with both feet.
9. **Front Support**: Flex and extend the arms.
10. **Lying on the Ground**: Raise the legs high and lower them to ground level.
11. **Quadruped Position**: Extend the legs to the side, bend them while raising the opposite arm.
12. **Standing Position**: Jumping jack with a jump upward.