



The Effectiveness Of Tabata-Style Training Exercises In Improving Cardiorespiratory Fitness And Certain Physical Abilities Of Tennis Players Under 16 Years Of Age

¹Lubna Abdulsool Shakir*, ²Barakat Mohammed Ali Dheyaa, ³Ola Raheem Hasan³

^{1,3} Faculty of Physical Education and Sports Sciences, University of Karbala

² Faculty of Dentistry, Student Activities Division, University of Karbala

Corresponding author: lubna.a@uokerbala.edu.iq

Abstract

This research aimed to identify effect of Tabata exercises on developing cardiorespiratory fitness and some physical abilities of tennis players under 16 years of age. experimental method, using a pre-test/post-test with equivalent groups, was employed as it was suitable for research problem. research population consisted of ten (10) tennis players under 16 years of age at Al-Durra Sports Club during 2025 season. research sample was selected using a census method, meaning sample represented entire research population. sample was divided into two groups (control and experimental), with five players in each group. the researcher developed Tabata exercises, which were performed during special preparation period in main part of training session, specifically at beginning of main session. training cycle for first two weeks consisted of 15 seconds of work followed by 15 seconds of rest after 8 repetitions, with a one-minute rest period between sets. training load for remaining weeks consisted of 20 seconds of work followed by 10 seconds of rest, with 5 repetitions and a one-minute rest period between sets. intensity used ranged from 85% to 90% of maximum training value, employing high-intensity interval training (HIIT). One of key findings was that Tabata exercises had a positive effect on improving cardiorespiratory fitness in research participants because they targeted working muscles of tennis players.

Keywords: Tabata-Style Training, Sport Exercises, Cardiorespiratory Fitness, Physical Abilities, Tennis.

Introduction:

process of sports training contributes to athletes reaching high levels through comprehensive development of all physical, functional, and skill-related aspects. This has led experts and specialists to search for modern and diverse methods that include training approaches supporting existing educational and training methods to enhance athletes' performance. Among these methods is mental training, which incorporates effective cognitive procedures and tools to positively influence kinetic performance. Tennis is one of individual sports that is characterized by abundance of diverse defensive and offensive kinetic skills, in which players exert great effort during

training or during matches. Players need integration of all physical and functional qualities and abilities. Physiological variables play an important role in sports field, as they determine player's abilities and extent of his ability to continue performing physical exertion. Therefore, coaches must pay attention in their training programs and include special and varied exercises that require preparing tennis players to be distinguished by abilities that enable him to perform his skills with full effectiveness. One of these exercises is Tabata exercises, which are considered among important exercises, as these exercises are performed at a high intensity, involving various muscle groups. Due to special nature of tennis in terms of time and nature of physical effort from serves, forehand and backhand strokes, speeds and different distances, tennis player's good utilization of his functional and physical abilities and capabilities is basic element to enhance and develop his level of performance. To fully utilize his skill potential, he needs to develop his physical abilities and improve physiological aspects of cardiorespiratory fitness, as these are important indicators of an athlete's functional competence. Therefore, importance of this research lies in developing specific training programs based on Tabata method and understanding their impact on physiological and physical capabilities of young tennis players.

Research Problem: Tennis is a sport that demands high levels of physical and physiological capabilities, which are crucial for skill performance. researcher, a former national team tennis player, observed a clear weakness in physical abilities, particularly during extended matches. This suggests a lack of sufficient physical training to sustain performance and exert physical effort for longer periods. This may stem from insufficient attention to modern training methods, such as Tabata exercises, which are essential for developing physical and cardiorespiratory fitness, enabling athletes to maintain physical exertion for extended durations. Therefore, the researcher developed Tabata exercises and investigated their impact on physiological and physical capabilities of tennis players under 16 years of age.

Research Objectives:

- To develop Tabata exercises for tennis players under 16 years of age.
- To identify effect of Tabata training on developing cardiorespiratory fitness and some physical abilities in tennis players under 16 years of age.

Research Hypothesis:

- There is a positive effect of Tabata training on developing cardiorespiratory fitness and some physical abilities in tennis players under 16 years of age.

Research fields:

- Human field: Players of Durrat Karbala Sports Club for 2024-2025 training season.
- Time field: (19/6/2025) to (1/8/2025)
- Spatial field: tennis court at Durrat Karbala Sports Club and laboratory of College of Physical Education and Sports Sciences – University of Karbala.

Terminology

Tabata exercises: These are a form of high-intensity interval training (HIIT), consisting of eight rounds (repetitions) of high-intensity exercises in a period of 20 seconds of work and 10 seconds of rest. It may only take four minutes to complete a Tabata circuit, but those four minutes may push your body to its limit. (Emberts et al.,2013).

Research Methodology and Field Procedures:

Research Methodology:

experimental method was used with a pre-test/post-test approach using equivalent groups, as it was suitable for research problem.

Research Population and Samples:

research population consisted of ten (10) tennis players under age of 16 at Durrat Karbala Sports Club for 2025 season. research sample was selected using a census method, meaning sample represented entire research population. sample was divided into two groups (control and experimental), with five (5) players in each group.

Equipment and Tools Used in Research:

- Observation.
- Testing and Measurement.
- One (1) Fitmate Pro device, German made.
- One (1) Trademail device, German made.
- One (1) Sony video camera, Japanese made.
- Manual sensor.
- Measuring tape.
- Obstacles of varying heights
- Casio electronic timer (Japanese made)
- tennis balls
- Tennis rackets

Description of Tests Used in Research:

First: Bruce Test for measuring cardiorespiratory fitness (GhassanBahriShamkhi, 2012)

- Equipment and Tools: Fitmate Pro device using a treadmill.
- Procedure Description: subject's data is entered into Fitmate Pro device, as required, and then cardiorespiratory fitness test is selected.
 - subject performs a short warm-up on treadmill (treadmill) by controlling speed for (3-5) minutes before performing actual test.
 - subject gets on treadmill (treadmill) and then puts on heart rate monitor and VO2max mask for Fitmate Pro device.
 - treadmill is started, followed by Fitmate Pro device, which has been pre-set to VO2max test.
 - Here begins Bruce's method of performing progressive exertion, as person conducting test promises to increase speed and incline of treadmill every three minutes (increase intensity every three minutes), and tester continues to perform until exertion is exhausted, and then presses end button for treadmill and Fit mate pro device.
- Scoring: result is calculated based on VO2max value measured in milliliters per kilogram per minute (ml/kg/min) by device.

Second: Explosive Power Test of Arms (Muhammad Subhi Hassanin and Hamdi Abdel Moneim, 1998).

- From a standing position, throw a 3 kg medicine ball forward with both hands overhead.
- Purpose of test: To measure explosive power of arm muscles.
- Equipment needed measuring tape, 3 kg medicine ball, whistle to signal start, chalk.
- Performance description:
 - athlete stands with their feet shoulder-width apart behind throwing line drawn on floor, holding medicine ball in front of their chest.

- starting signal is given to athlete, who then throws medicine ball forward as far as possible.
- Test instructions:
 - athlete must assume correct position (standing with their feet shoulder-width apart) with medicine ball in front of their chest.
 - athlete must not touch line drawn on floor.
 - athlete must not lift their feet off ground during performance.
 - Perform an arc with your back, bringing medicine ball backward with your arms, and then throw it forward as far as possible.
- Speed of execution.
 - Each player has two attempts; best one is recorded.
 - score achieved by each player is announced to next player to ensure a competitive environment.
- Scoring: distance, in meters and fractions thereof, is measured and recorded for each player from throwing line to point where medicine ball lands.

Third: Leg Muscle Strength Endurance Test (Full Standing Bend for 60 Seconds) (Ali Salman Abdul Tarfi ,2013.)

- Purpose of test: To measure strength endurance of leg muscles.
- Equipment needed:
 - Electronic stopwatch and whistle.
 - Recorder: To record number of repetitions (full leg bending and extension, counting number in 60 seconds).
 - Timer: To give start and end signals, time repetitions, and observe accuracy of test and count.
- Performance: From a standing position, fully bend and extend legs, counting number in 60 seconds.
- Test instructions: Full knee bending and extension. Each player is given only one attempt.
- Recording: Count number of correct repetitions (full knee bending and extension) for 60 seconds.

Fourth: Fast Arm Power Test. (YassineNaji, Bastawisi Ahmed. 1987):

- forward-leaning push-up test for (10) seconds.
- Test Purpose: To measure fast power of arm and shoulder muscles.
- Scoring Method: number of correct push-ups within (10) seconds is counted for player performing test.

Exploratory Test:

Exploratory test was conducted on a sample of (3) players from outside research sample on June 19, 2025, at tennis court in Al-Durra Sports Club in Holy Karbala Governorate. Its objectives were:

- To verify validity of methods used when administering test.
- To ensure clarity of test instructions and players' understanding of their application.
- To assess suitability of test duration.

Pre-Tests:

pre-tests were conducted from June 21-22, 2025, at 6:00 PM in laboratory of College of Physical Education and Sports Sciences, University of Karbala, and at Al-Durra Sports Club in Karbala Governorate, as follows:

Day 1: Cardiorespiratory Fitness Measurement: pre-test for this variable was conducted at 6:00 PM in laboratory of College of Physical Education and Sports

Sciences, University of Karbala. Measurements were taken from both experimental and control groups, totaling 10 players, and data were recorded for statistical analysis.

Day 2: Physical Abilities Measurement: This took place at 6:00 PM on tennis court at Al-Durra Sports Club in holy city of Karbala.

Homogeneity and Equivalence of Research Sample:

Honorability and equivalence were established between two groups in tests administered to players in Exploratory study, as shown in Table (1) and Table (2).

Table (1) shows homogeneity of sample.

No.	Variables	Measuring unit	value(Leven)		Level Sig	Type Sig
			calculated	sig		
1	Height	cm	1,342	0,444	Non-sig	homogeneity
2	Mass	kg	0,887	0,297	Non-sig	homogeneity
3	Chronological Age	year	0,129	0,892	Non-sig	homogeneity
4	Training Age	year	1,093	0,889	Non-sig	homogeneity

Table (2) represents equivalence between research sample and researched variables.

Variables and Measurements	Unit of Measurement	Experimental group		Control group		T value		Type Sig
		Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation	calculated	Sig	
Cardiorespiratory fitness	ml L/kg min	38.130	1.043	38.070	1.514	0.073	0.944	Non-sig
Explosive Power Test of Arms	m	3,888	1,789	3.787	1.898	1.874	0.222	Non-sig
Fast Arm Power	number	7.797	2.777	6.956	2.343	1.654	0.132	Non-sig
Leg Muscle Strength Endurance	number	45.400	1.140	45.200	1.303	0.258	0.803	Non-sig

Tabata Exercises Developed by Researcher:

After reviewing available scientific sources and consulting with several experts and specialists in field of sports training and tennis, the researcher developed his Tabata exercises. details of exercises are as follows:

- 1- exercises were performed during specific preparation period.
- 2- the researcher determined number of weekly training sessions to be two sessions on Sundays and Tuesdays, totaling 16 training sessions.

- 3- A portion of main section of training session was used, specifically beginning of main section.
- 4- training cycle for first two weeks consisted of 15 seconds of work followed by 15 seconds of rest after 8 repetitions, with a one-minute rest period between sets.
- 5- training cycle for remaining weeks consisted of 20 seconds of work followed by 10 seconds of rest, with 5 repetitions and a one-minute rest period between sets.
6. duration of each training session is 24-30 minutes.
- 6- 7. intensity used ranges from 85-90%.
- 7- 8. training method used is high-intensity interval training.

Main Experiment:

main experiment was conducted on experimental group, consisting of 5 players, from June 25, 2025, to August 25, 2025.

Post-Tests:

post-tests were conducted on August 27-28, 2025, under same conditions as pre-tests, and results were confirmed.

Statistical Methods Used in Research:

The researchers used SPSS statistical package to verify research data.

Presentation, Analysis, and Discussion of Results:

Presentation and Analysis of Results:

Presentation and Analysis of Pre- and Post-Test Results for Experimental and Control Groups:

Table (3) Shows means for pre- and post-tests for experimental and control groups and calculated t-values

Variables	Groups	Pre-test		Post-test		T value	Level Sig	Type Sig
		Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation			
Cardiorespiratory fitness	Experimental	38.130	1.043	41.960	1.177	15.55	0.000	Sig
	Control	38.070	1.514	38.126	1.519	4.106	0.015	Sig
Explosive Power Test of Arms	Experimental	3,888	1,789	5.887	1.887	9.564	0.000	Sig
	Control	3.787	1.898	4.823	2.983	5.866	0.000	Sig
Fast Arm Power	Experimental	7.797	2.777	13.854	3.675	8.876	0.000	Sig
	Control	6.956	2.343	10.665	2.987	6.897	0.000	Sig
Leg Muscle Strength Endurance	Experimental	45.400	1.140	54.400	5.224	3.674	0.021	Sig
	Control	45.200	1.303	46.600	1.516	5.715	0.005	Sig

Presentation and Analysis of Post-Test Results for Experimental and Control Groups

Table (3) shows means for post-tests of experimental and control groups, calculated t-value, and its statistical significance for tested tests.

Variables and Measurements	Experimental group		Control group		T value	Level Sig	Type Sig
	Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation			
Cardiorespiratory fitness	41.960	1.177	38.126	1.519	11.973	0.000	Sig
Explosive Power Test of Arms	5.887	1.887	4.823	2.983	5.903	0.000	Sig
Fast Arm Power	13.854	3.675	10.665	2.987	7.992	0.000	Sig
Leg Muscle Strength Endurance	54.400	5.224	46.600	1.516	4.823	0.000	Sig

Discussion of Results:

By examining results in Tables (3 and 4), we find an improvement in results of variables under investigation for both experimental and control groups in post-test compared to pre-test. This indicates that training program developed by the researcher (Tabata training) had a positive impact on studied variables. Generally, sports training references we have cited emphasize necessity of planning training program to achieve objectives that translate into observable and measurable performance, which is precisely what the researcher strived to achieve.

The researcher attributes improvement achieved by experimental group in post-test to nature of Tabata exercises, which the researcher prepared based on well-studied scientific principles in order to enhance specific endurance capabilities, as Tabata exercises play a major role in developing strength endurance. "training based on gradual increase in training load from one training unit to another, with an appropriate increase, will lead to appropriate muscular adaptation to this increase, which leads to an improvement in strength endurance. Therefore, trainee must set specific goals for his capabilities." (Adel Turki Hassan Al-Dalawi, 2011)

This is what confirmed: Tabata training, which consists of very high-intensity repetitions with short rest periods, is a very challenging physical exercise and is used to develop anaerobic abilities. (Foster, et al., 2015).

The researcher also attributes improvement observed in control group in post-test to players' continued training with coach's exercises, which aimed at strength endurance. Continuous, programmed training develops specific physical abilities and brings performance times up to competitive levels. training load must be programmed to develop strength endurance by linking physical exercises with skill-based drills to raise training level. (Amer Fakher Shaghati, 2011)

the researcher attributes this improvement to exercises he developed, which were meticulously prepared based on studies, research, and other sources. From outset, the researcher considered principle of organizing these exercises and implementing them within training units. This allows for structured training of specific skill to align with desired objective.(Tariq Mohammed Abdul Raouf,1998)

principle of progression from easy to difficult and from simple to complex is also employed. This progression ensures regular coordination and connection between exercises used in training unit, with their intensity and volume increasing progressively according to player's training level.(Qasim Hassan, Mahmoud Abdullah,1987)

Tables (3) and (64) clearly show significant differences between pre-test and post-test for two research groups (control and experimental). This indicates an improvement in cardiorespiratory fitness variable, favoring post-test for both groups. the researcher attributes improvement in experimental group to nature of Tabata exercises, which were applied scientifically and systematically. For tennis players who exert physical effort during training and matches, cardiorespiratory fitness is a fundamental requirement that must be considered when designing training units and exercises. Therefore, we emphasize necessity of developing this physiological variable through training. A two-month training period is sufficient to increase a player's ability to perform tasks at maximum capacity. This is what the researcher was able to achieve through exercises designed for experimental group. These exercises played a role in promoting regular training, which led to adaptation in respiratory system and increased its efficiency. This, in turn, improved muscular system's ability to extract oxygen, thus increasing its capacity for increased consumption. Confirmed that high-intensity interval training protocol used in Tabata training principles is a time-efficient training protocol that can be safely used to induce physiological responses to improve circulatory-respiratory and metabolic functional fitness. (Williams & Kraemer, 2015)

Conclusions:

Tabata exercises had a positive effect on improving cardiorespiratory fitness among research participants because they targeted working muscles of tennis players. Tabata exercises had a positive effect on developing physical abilities among research participants because they targeted working muscles of tennis players. Tabata exercises helped break training routine, leading to improved results. Tabata exercises contributed to reducing training time.

Recommendations:

According to researcher's conclusions, which demonstrated effectiveness of using Tabata exercises, the researcher recommends following the researcher recommends focusing on using Tabata exercises according to scientific training principles to enhance anaerobic efficiency of tennis players during matches. - Conduct similar studies using Tabata training for other sports that require speed, strength, power, and endurance. Conduct similar studies on samples of different age groups to develop physical abilities important for tennis players.

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Appendix (1)

Exercises Used in Research:

- 1- Lateral Jump: From starting position, jump upwards over cone to other side, then jump to other side, and so on, while pulling knees.
- 2- Medicine Ball Throw from a Seated Position: Two players sit facing each other. One player holds ball to their chest and begins exercise by passing it to other player, who then returns pass, and so on. ball is thrown with both hands (chest pass), using glutes, abdominal muscles, and arm muscles.
- 3- Jumping forwards over cones (30-40 cm) continuously with both feet, emphasizing upward jumps. There are 10 cones.
- 4- Jumping off Swedish benches (40-50 cm) and landing on ground with both feet continuously.
- 5- Jumping forwards over hurdles (50 cm) with both feet, keeping body vertical while swinging arms to achieve desired height.
6. Medicine Ball Throw: player throws a medicine ball (weighing 3 kg) upwards and catches it.
- 1- From a forward support position, perform exercise for 30 seconds upon hearing coach's whistle.

- 2- Reactive Ball Drill: Throw a reaction ball to ground and attempt to catch it quickly.
- 3- Jump Rope Drill.
- 4- Perform serve using a weighted racket.
- 5- player moves laterally between two points, right and left, and at each stop performs a quick forehand or backhand shot.

Appendix (2)

Sample training unit from first week

Units	Exercise	Intensity %	Repetitions (time) (sec)	Repetitions	Rest between repetitions(sec)	Sets	Total time(minute)
First	Third	85%	15	8	15	1	4
	Seventh	90%	15	8	15	1	4
	Ninth	85%	15	8	15	1	4
Second	First	85%	15	8	15	1	4
	Fourth	90%	15	8	15	1	4
	Eighth	85%	15	8	15	1	4