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The effectiveness of a training program based on intermittent training in developing physical fitness variables among faculties' students of physical education and sports sciences in Iraq

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Abstract

The research aimed to prepare a training program based on the use of the intermittent training method in developing physical fitness among students. To identify the effectiveness of a training program based on intermittent training in developing physical fitness variables among students of the faculties of physical education and sports sciences in Iraq. After identifying the level of possession of faculties' students of physical education and sports sciences in Iraq of physical fitness variables. The researcher used the experimental method with a tight control design for two equal groups in number with a pre-and post-test. The researcher identified the research sample as the players of the College of Physical Education and Sports Sciences team at the University of Kirkuk in basketball who belong to the college stages (first, second, third, and fourth), academic year (2022-2023). They are numbering (40) players distributed into two control and experimental groups with (20) players for each group. The researcher developed his training program according to scientific foundations which included various activities and exercises. The training program lasted for (8) weeks with two training units per week. One, the high-intensity interval training method was used from (80% - 90%) and after completing the research experiment extracting the results, conducting and statistically

processing the tests and discussing the results. The researcher concluded a set of conclusions, which are:

- The training program based on intermittent training has a positive effect on the development of physical fitness elements among students of the College of Physical Education in Iraq.

- The training program based on intermittent training for the experimental group had an advantage over the approach followed in training for the control group in developing physical fitness variables among players.

Keywords: Intermittent training, physical fitness

Introduction

Sports training represents the pinnacle of physical and mental adaptation in humans. It is a comprehensive process that aims to develop the skills, physical qualities and mental stability of athletes in various sports disciplines. This multi-faceted endeavor goes beyond the process of developing the elements of physical fitness. these elements include precise sports planning processes, rigorous sports practice methods, and personal guidance mechanisms to unleash the full potential of athletes pushing them towards peak performance. Sports training in its essence includes a strategic combination of physical adaptation, technical improvement, and mental preparation starting from strength, speed, endurance and agility training to developing sports-specific skills. Recently, a multi-faceted approach has emerged in the sports training field that represents an effective methodology designed to improve performance, enhance endurance, and stimulate metabolic adaptations. This innovative training strategy revolves around alternating periods of intense exercise with periods of rest or less intense activity, creating a dynamic stimulus that elicits a range of physiological

responses and their benefits for improving performance. This type of training challenges the body's ability to adapt to fluctuating sports demands reflecting the different nature of many sports. Activities that require bursts of energy interspersed with periods of recovery, by incorporating cycles of high-intensity efforts followed by active or passive recovery periods. Athletes can enhance their cardiovascular fitness, improve their anaerobic capacity, and adjust their energy systems to meet the demands of their sport. One of the hallmarks of interval training is its versatility and scalability and its ability to accommodate athletes of different fitness levels and training goals. It used in running-based disciplines, team sports, or endurance events. This type of training called interval training, targets specific energy systems, different movement patterns, and performance measures, providing a tailored approach to enhancing athletic capabilities. (Smith et al, 2013) state that interval training is a form of modern, qualitative physical training that uses resistance exercises. its purpose is to increase physical capabilities and improve physical fitness in a varied and continuous manner by performing physical and functional movements at relatively high intensities. (Smith et al., 2013, p. 3159)

The statement of problem

Despite the types of sports training practiced by physical education and sports science students within the educational subjects prescribed for them in the various college stages. These students often face challenges related to their abilities and physical fitness which require focused attention through training. These challenges may be manifested in the inability of their circulatory systems to endure, their limited muscle strength and flexibility, and the inability of the exercises they practice to develop their motor skills. In addition, individual differences in fitness levels and previous sports experience among a diverse group of students may constitute another challenge due

to the inability of the designs of training programs prepared by teachers to meet the different physical needs of all students. Most of the subjects prescribed in the faculties of physical education and sports science are presented in a traditional manner often focus on developing skills more than on the physical aspect based on the effort that the heart and blood vessels may exert continuously. By following up on the training of sports teams in the College of Physical Education / University of Kirkuk, researchers noticed that they are still proceeding at a single pace in terms of training methods. Their use of training methods that may not meet the physical and psychological needs of students which may cause a decline in the level of their performance is due to their low levels of physical fitness. The researchers tried to formulate the problems that students may face during training within college teams through a set of questions:

- Do students of the faculties of physical education and sports sciences in Iraq have physical fitness? And what is the level of this fitness?
- Does the training program based on intermittent training affect the development of physical fitness among Faculty's students of Physical Education and Sports Sciences in Iraq?

Research objectives

-Preparing a training program based on the use of the intermittent training method in developing physical fitness among students.

-Identifying the level of possession of physical fitness variables among the faculties ' students of physical education and sports sciences in Iraq.

-Identifying the effectiveness of a training program based on intermittent training in developing physical fitness variables among students of the faculties of physical education and sports sciences in Iraq.

Research hypotheses

-There are statistically significant differences between the results of the pre- and post-tests of the experimental group in the variables of physical fitness among students the College of Physical Education in Iraq with favor of the post-test.

-There are statistically significant differences between the results of the post-test of the experimental and control groups in the variables of physical fitness among College's students of Physical Education in Iraq with favor of the experimental group.

Research areas

-**Human field:** Students of the College of Physical Education and Sports Sciences/ University of Kirkuk/ academic year (2022/2023), the participants is the college basketball team.

-**Time field:** The time period extending between (1/11/2022) and (1/51/2023)

-**Spatial field:** The playgrounds the College of Physical Education and Sports Sciences/ University of Kirkuk

Research terms

Interval training

A type of physical activity characterized by alternating periods of high-intensity exercise with rest or low-intensity activity. This is allowing individuals to push their bodies to higher intensities during active phases while providing opportunities for recovery. It can be beneficial for improving cardiovascular fitness, endurance, and overall performance, as well as enhancing the body's adaptation to various stressors.(Pryor et al., 2019, p. 1)

Physical fitness

Is a set of physical abilities that contribute to improving athletes' performance. These abilities include several key components such as the ability to move quickly, strong muscle performance, as well as the ability to maintain continuity in sports activities for long periods. also, the ability to maintain stability during movement and move joints and muscles with a wide range. The elements of physical fitness help athletes compete better in various sports. (Xiao et al., 2021, p. 1)

Research Methodology

The researchers chose the experimental method with a design of two equal with tight control. It consists of pre- and post-tests for each group due to its suitability with the research's nature and its problem. The researchers used the cross-training program for the experimental group. While the control group applied the traditional program followed by the team coach. After the program period for the two groups ended, a comparison was made between them in terms of physical fitness variables.

The research community

The research community was determined by the sports students belonging to the morning study/ College of Physical Education and Sports Sciences/ University of

Kirkuk/ academic year (2022-2023). The researchers chose the students who represent the college basketball team as the main sample for the research. These students, numbering (40) students, belong to the four stages of the college (the first stage, the second stage, the third stage, the fourth stage) with (10) students for each stage. They were chosen intentionally at a rate of (100%) from the original community. The main sample was divided into two groups of equal numbers by lottery, with (20) students for each group from the experimental and control groups.

Homogeneity of the research sample

The aim of conducting the homogeneity process between the individuals of the research sample is to ensure that the differences in the results between the two groups are the result only of the intervention was carried out . Not due to any other possible factors, i.e. making the two groups homogeneous in all factors except for the independent variable whose effect is being tested. To ensure the research's integrity . the researcher and the assistant work team recorded the measurements of the anthropometric variables in (height - mass) and chronological age. Then It extracted the coefficient of variation for each homogeneity variables. These procedures were carried out on 12/5/2022, it was found that the coefficient of variation ranges between (1-30), and the closer its value is to (1), the higher the homogeneity, as shown in Table (1)

Table (1)

shows the homogeneity of the control and experimental group sample

coefficient of variation	Deviation standard	Arithmetic medium	Measurement unit	Variables
1,32	3,43	182,75	cm	**Length**

4,69	3,58	76,32	kg	**Mass**
8,68	1,94	22,35	years	**Chronological age**
15,78	1,14	7,22	years	**Training age**

(n=40)

Equivalence of the research groups

The purpose of finding the equivalence factor between the experimental group and the control group in the experimental research is to increase the level of similarity between the two groups, so that this contributes to controlling the various factors other than the independent variable whose effect is intended to be tested, and that by achieving equivalence, researchers can be more confident that any variation in the results between the two groups can be attributed only to the independent effect being tested. The researcher, after controlling the homogeneity between the individuals of the research sample and dividing them into two groups, experimental and control, found equivalence between these two groups, and Table (2) shows the equivalence between them.

Table (2) shows the equivalence between the experimental and control groups.

Significance	Calculated	Experimental group		Control group		Measurement Unit	Tests
		Standard deviation	Arithmetic mean	Standard deviation	Arithmetic mean		
Not significant	**1,57**	**2,58**	**361,33**	**3.43**	**358,83**	**cm**	**Explosive strength of arms**
Not significant	**0,34**	**3,18**	**47,83**	**2.92**	**48,16**	**cm**	**Explosive strength of legs**
Not significant	**0,85**	**0,13**	**5,66**	**1.17**	**5,32**	**Time/sec**	**Transitional speed**
Not significant	**0,65**	**3,18**	**27,98**	**2.17**	**27,42**	**Number x Time**	**Motor speed of arms**
Not significant	**0,71**	**3,52**	**33,16**	**3.41**	**32,38**	**Degree**	**Shoulder flexibility**

Significance	Calculated	Experimental group		Control group		Measurement Unit	Tests
		Standard deviation	Arithmetic mean	Standard deviation	Arithmetic mean		
Not significant	0,44	0,76	6,84	0,98	6,97	Time/sec	Agility

The tabular (T) value is equal to (2.02), at the significance level (0.05), degree of freedom (18). Table (2) shows that the differences were not significant between the individuals of the experimental and control groups in measuring some elements of physical fitness, because the calculated (T) values for all variables were smaller than the tabular (T) value at the significance level (0.05) and degree of freedom equal to (18), which indicates that the two groups are equivalent.

Data collection methods

To determine the methods used to collect research's data. They based on Arab and foreign sources, theses, dissertations, research and scientific journals were relied upon to write the theoretical framework. While personal interviews were adopted directly or through means of communication with a number of experts specializing in physical education in a number of specialized colleges within the field application aspect of the research procedures. The researcher also used questionnaire forms to determine the elements of physical fitness and their appropriate tests. In addition to taking their opinions on the validity of the training program prepared by the researcher.

Determining the physical fitness' elements and their tests

To determine the most important elements of physical fitness in basketball, the researcher reviewed the scientific sources of Eastern and Western schools. The researcher designed a questionnaire form containing a number of elements, it was distributed to a group of experts and specialists in the field of sports training science and basketball, numbering (8) individuals and basketball. Their details are included in

Appendix (1), as it is mentioned () that there is different importance, priorities and percentages of the required physical variables according to the requirements of each competition. (Othman, 1999, p. 94). The distributed form included how to answer it, by placing a mark (□) in front of the evaluation score for the sequence (1-2-3-4-5) for each element of physical fitness, making any observation that the specialist and expert deems necessary as in Appendix (2), noting that the researcher relied on a percentage (100%) that the physical element must achieve from their opinions, as shown in Table (3).

Table (3)

shows the percentage of identifying the most important physical fitness elements according to the opinions of experts

Expert Opinion	Relative importance	Elements of Physical Fitness	Ser.
Acceptable	%100	Muscular Strength	1
Acceptable	%100	Speed	2
Excluded	%74	Endurance	3
Acceptable	%100	Flexibility	4
Acceptable	%100	Agility	5
Excluded	%70	Coordination	6
Excluded	%72	Balance	7
Excluded	%60	Accuracy	8
Expert Opinion	%70	Cyclic Respiratory Endurance	9

After identifying the most important elements of physical fitness by the specialized experts. Aa second questionnaire was designed that included the appropriate tests for the selected elements of physical fitness as in Appendix (3). It was distributed to the specialized experts and they were answered by placing a mark (□) in front of the evaluation score for the sequence (1-2-3-4-5) for each test, and making any

observation that the specialist and expert deem necessary, noting that the researcher relied on the percentage (100%) that the test must achieve, as shown in Table (4).

Table (4)
shows the percentage of identifying the most important physical fitness elements tests according to the experts' opinions

Percentage%	determined by experts	Selected fitness elements		Ser.
%100	Sargent Vertical Jump Test	Explosive Power	Muscle Strength	1
%100	Medicine Ball Push Test (3) kg			
%100	Sprint Test (20m) and Start from (30m)	Transitional Speed	Speed	2
%100	Horizontal Arm Movement Test	Motor Speed		
%100	Shoulder Flexibility Test (Shoulder Lift	Shoulder Flexibility	Flexibility	3
%100	Zigzag Running Test (3 x 9m)	Agility		4

The following is an explanation of the physical research tests:

First: Sargent's vertical jump test

-Test objective: to measure the explosive power of the legs in the vertical jump upwards.

(Alawi and Radwan, 1994, p. 84)

Second: Medicine ball push test (3) kg

-Test objective: to measure the muscular strength of the arms and shoulders. (Alawi and Radwan, 1994, p. 110)

Third: Running test (20 m) and starting from (30 m) (Ali, 2004, 39)

-Test objective: to measure the transitional speed and fast start. (Ali, 2004, p. 39)

Fourth: Testing the movement of the arm in the horizontal direction

Test objective: Measure the motor speed of the arms. (Hassanin, 1995, p. 310)

Fifth: Shoulder flexibility test (shoulder lift)

- Test objective: Measure the ability to lift the shoulders up from a prone position.

(Abu Zaid, 2005, p. 409)

Sixth: Zigzag running test (zigzag) 3 x 9 m

- Test objective: Measure the ability to change direction while running.

(Alawi and Radwan, 1994, p. 302)

Scientific foundations for selected physical fitness elements tests

3.5.1 Test validity

Validity refers to the extent which a test can accurately and objectively measure what it is supposed to measure. A test is considered valid if it measures the concept or trait it was designed to measure and nothing else. (Puri, 2019, p. 121), and (Muhammad, 1999) indicates that the validity coefficient depends on the reliability coefficient, increasing with its increase and decreasing with its decrease. (Muhammad, 1999, p. 42), so the researcher used self-validity, which is measured by calculating the square root of the test reliability coefficient, as shown in Table (5).

3.5.2 Test stability

To achieve test stability, the retest method was used. The researcher applied the test to a sample of (12) players representing the University of Kirkuk basketball team, who were outside the research sample. The test was repeated under the same conditions. Then the correlation coefficient between the two tests was extracted using the Spearman correlation law for each test. When comparing the calculated value with the tabular value at a degree of freedom (12-2) under a significance level of (0.05), it was found that the calculated value for each test is greater than the tabular value (0.497), which indicates that the tests have a high degree of stability, as in Table (5).

Table (5)
shows the tests and the correlation coefficient between the first and second tests, the tabular value, the probability of error, the degree of freedom, and the significance of the reliability of the tests.

Significant	Degree of freedom	Probability of error	Table value	Correlation coefficient between the two tests	Unit of measurement	Tests	Ser.
Moral	2-12	0,05	0,497	0,92	degree	Explosive arm strength	1
Moral				0,93	degree	Explosive leg strength	2
Moral				0,97	time/second	Transitional speed	3
Moral				0,96	time/second	Motor speed of arms	4
Moral				0,94	degree	Shoulder flexibility	5
Moral				**0,98**	time/second	Agility	6

Objectivity of tests

One of the conditions that must be met in the test is objectivity, as (Salama, 1980) states that a test with good objectivity is the test that removes doubt and disagreement from the testers when applying it. (Salama, 1980, p. 79). Since the physical tests were presented to a group of experts and specialists obtained an agreement rate of (100%). In addition to the fact that the tests used in this research depend on simple, clear and easy-to-understand vocabulary and are far from self-assessment and effort, as the recording is done using units (time/second, repetition, distance/centimeter), thus the tests are considered objective.

Exploratory studies

The researcher conducted a number of exploratory experiments, each with a specific purpose. To control the obstacles that may appear when implementing the main research experiment. The experiments were conducted on a sample consisting of (12) players from the students who represent the University of Kirkuk basketball team. They were conducted in the university's sports hall; these studies are classified as follows:

The exploratory study

The purpose which was to verify the validity of the physical tests and the sample's understanding of the applying method and organizing the tests. It was conducted on Monday (6/2/2023), as well as clarifying the method of conducting the tests for the auxiliary work team, the safety of the tools used, and the time taken for each test.

1.Knowing the validity of the scale paragraphs and their suitability for the research sample.

2. Knowing the time taken to answer the scale, and in light of the results of the exploratory experiment, the time to answer the scale was set at a time ranging between (25-30) minutes.

3.Ensuring that the research sample members understand the scale instructions.

4. Knowing the adequacy of the auxiliary team.

5. Knowing the difficulties that may face the workflow and developing appropriate solutions for them.

6. Achieving scientific foundations.

The third exploratory study

The purpose of which was to determine the prepared exercises, the tools used, and to determine the intensity and duration of the exercise, and the appropriate rest periods according to scientific foundations, and the mechanism for organizing the training program and the method of applying its components, in addition to ensuring the suitability of the sports hall, and after the researcher confirmed its suitability, the researcher conducted the exploratory study on (Thursday) corresponding to (2/16/2023).

Design of the intermittent training program

The goal of the program

Developing the elements of physical fitness (explosive strength of the arms and legs, transitional speed, motor speed of the arms, flexibility, and agility) among students from the basketball team players of the College 's students of Physical Education and Sports Sciences at the University of Kirkuk.

Foundations of the intermittent training program

1.Paying attention to warm-ups and stretching exercises at the beginning of the training unit.

2.The exercises should be appropriate for the level and capabilities of the players.

3.The element of excitement and change should be available in the exercises used. 4.Gradual and fluctuating intensity of training loads using the high-intensity interval training method from (80% to 90%), with adjusting the training volume (repetitions, number of sets, and rest periods between repetitions and sets), taking into account avoiding overload, as the intensity of training units was determined between (80-90%) by measuring the maximum performance time for repetitions and each exercise according to the following equation:

$$\frac{\text{Maximum performance time for repetitions} \times 100}{80\text{-}90\%}$$

5.The researcher used the stations method for the purpose of applying the exercises so that the player performs the exercise and then moves to the other exercise, and that foam roll-link exercises are used after completing the strength,

speed, and agility exercise as a condition that provides relaxation and muscle stretching.

6.Paying attention to the final section of the training unit to provide recovery.

Content of the Intermittent Training Program

The researcher prepared his training program for the purpose of developing some elements of physical fitness (explosive power, transitional speed, motor speed, flexibility, and agility). With the program including some sports games far from the players' specialization, It included exercises using a weight vest, weight jet, medicine balls, jumping exercises, leg movements on the agility ladder, foam rolling exercises, and swimming exercises. The following is the movement of the training load for the program which took two months (8) weeks at a rate of two training units per week from Monday to Wednesday, consists of two medium cycles and each cycle consists (4) small cycles. The high-intensity interval training method was used from (80% - 90%), the size of the training loads was controlled by controlling the exercise duration, which indicates the presence of rest periods between the program components. As the rest periods are estimated from (45) to (90) seconds provided that the heart rate decreases to (120 to 130) beats per minute for performing repetitions. It is shown in Table (7). Each the training courses and details of the training program were presented to a group of experts and specialists in sports training science to learn their opinions about their suitability, they were approved at a rate of (100%).

Table (7) shows the training method and work / rest periods.

Second Intermediate Course				First Intermediate Course				Courses
8	7	6	5	4	3	2	1	Weeks / Load degree
	*				*			90%
*		*		*		*		85%

			*				*	80%

Pre-tests

The pre-tests were conducted after preparing the tools and supplies for the physical fitness elements tests. This test was with the help of the assistant work team, after providing the appropriate psychological atmosphere for the students, preparing the place for their implementation for the research sample members as follows:

Physical fitness elements tests

On (2/19/2023), the researcher applied the physical fitness elements tests in the closed sports hall affiliated with the University of Kirkuk - College of Physical Education and Sports Sciences. These tests included (explosive strength test for the arms and legs, transitional speed, motor speed, flexibility, and agility), with sufficient time given for warm-up and appropriate rest periods between one test and another.

Intermittent Training Program Application

The intermittent training program was applied to the experimental group on Monday (27/2/2023). The application process was completed on Thursday (27/4/2023). As for the control group, it followed the training method followed by the trainer. The training unit consisted of a group of sections as shown in Appendix (6). These sections are:

First: Preparatory Section (20) minutes

This section includes general and specific warm-ups for preparing the body, circulatory system and respiratory system. It also focuses on special flexibility exercises and muscle stretching.

Second: Main Section (60) minutes

In this section, the members of the experimental group apply intermittent training for developing the elements of physical fitness, by using the stations method. After completion, one of the sports activities such as swimming is practiced.

Third: Final Section (10) minutes

It includes foam rolling exercises, muscle relaxation exercises and recovery.

Post-tests

The researcher applied the post-tests to the research sample, after providing the same spatial and temporal conditions, the method of applying the pre-tests. The post-tests were conducted as follows:

Physical Fitness Elements Test

On Sunday, April 30, 2023, the post-test was applied to the elements of physical fitness in the indoor sports hall /University of Kirkuk - College of Physical Education and Sports Sciences. These tests included (explosive strength test for arms and legs, transitional speed, motor speed, flexibility, and agility), with emphasis on giving sufficient time for warm-ups and appropriate rest periods between one test and another.

Presentation, interpretation, and discussion of the results

Table (8)

shows the results of the pre- and post-test for the experimental group in the elements of physical fitness

Significance	Calculated value of (T)	A F	SA	Post-measurement		Pre-measurement		Measurement unit	Tests
				A	S	A	S		
Significant	29.55	8.68	57.33	3.50	418.66	2.58	361.33	cm	Explosive Arm Power
Significant	13.71	4.80	14.67	2.42	62.5	3.18	47.83	degree	Explosive Leg Power
Significant	7.2	1.14	1.8	0.13	3.86	1.38	5.66	Time/sec	Transitional Speed
Significant	7.44	3.12	7.45	2.08	35.43	3.18	27.98	Number x Time	Motor Speed of Arms
Significant	8.46	4.35	8.21	2.76	41.37	3.52	33.16	Degree	Shoulder Flexibility
Significant	3.77	3.13	2.64	0.61	4.20	0.76	6.84	Time/sec	Agility

***The tabular value of (T) is equal to (2.09), below the significance level of 0.05 and the degree of freedom (19).**

It is clear from Table (8) that the differences between the results of the pre- and post-tests of the experimental group were statistically significant. In favor of the post-tests especially in the tests (explosive strength of the arms, explosive strength of the legs, transitional speed, motor speed of the arms, shoulder flexibility, and agility).It confirms the positive effect of the intermittent training program for the experimental group, as follows:

•Explosive strength of the arms

The arithmetic mean value of the pre-test for the explosive strength element of the arms was (361.33) cm, a standard deviation (2.58), while the arithmetic mean value of the post-test was (418.66) cm, a standard deviation of (3.50). Since the calculated (T) value of (29.55) was greater than the tabular (T) value (2.09), the difference was statistically significant and in favor of the post-test at a significance level of (0.05). A degree of freedom = (19), and Figure (14) shows the values of the means Arithmetic of the pre- and post-tests related the experimental group in explosive strength of the arms.

Explosive strength of the legs

The arithmetic mean value of the pre-test for the legs' explosive strength was (47.83) cm, and a standard deviation of (3.18). While the arithmetic mean value of the post-test was (62.5) cm, a standard deviation of (2.42). Since the calculated (T) value of (13.71) was greater than the tabular (T) value of (2.09). The difference was statistically significant in favor of the post-test at a significance level of (0.05). A degree of freedom = (19). Figure (15) shows the values of the arithmetic means of the pre- and post-tests for the experimental group in explosive strength of the legs.

• **Transitional speed**

The pre-test arithmetic mean value for the transitional speed test was (5.66) seconds, and a standard deviation (1.38). While the post-test arithmetic mean value was (3.86) seconds, a standard deviation of (0.13). Since the calculated (T) value of (7.2) was greater than the tabular (T) value of (2.09). The difference was statistically significant in favor of the post-test at a significance level of (0.05), A degree of freedom = (19). Figure (16) shows the values of the arithmetic means for the pre-test and post-test for the experimental group in transitional speed.

• **Arm motor speed**

The arithmetic mean value of the pre-test for the arm motor speed element was (27.98) numbers per time, a standard deviation of (3.18). While the post-arithmetic mean value was (35.43) numbers per time, a standard deviation of (2.08). Since the calculated (T) value of (7.44) was greater than the tabular (T) value of (2.09). The difference was statistically significant in favor of the post-test at a significance level of (0.05), A degree of freedom = (19). Figure (17) shows the values of the arithmetic means for the pre- and post-tests for the experimental group in arm motor speed.

• **Shoulder flexibility**

The arithmetic mean value of the pre-test for the shoulder flexibility element was (33.16) degrees, a standard deviation of (3.52). While the post-test arithmetic mean value was (41.37) degrees, a standard deviation of (2.76). Since the calculated (T) value of (8.46) was greater than the tabular (T) value of (2.09). The difference was statistically significant in favor of the post-test at a significance level of (0.05), a

degree of freedom = (19). Figure (18) shows the values of the arithmetic means for the pre-test and post-test for the experimental group in shoulder flexibility.

- **Agility**

The pre-test arithmetic mean value for the agility test was (6.84) seconds and a standard deviation of (0.76). While the post-test arithmetic mean value was (4.20) seconds, and a standard deviation of (0.61). Since the calculated (T) value of (3.77) was greater than the tabular (T) value of (2.09). The difference was significant in favor of the post-test at a significance level of (0.05), A degree of freedom = (19). Figure (19) shows the values of the arithmetic means for the pre-test and post-test for the experimental group in agility.

Table (9)
shows the results of the post-tests between the control and experimental groups in the elements of physical fitness

Significance	T Calculated	Experimental		Control group		Measurement unit	Tests
		Standard deviation	Arithmetic mean	Standard deviation	Arithmetic mean		
Significant	16.35	3.50	418.66	3.31	401.16	Cm	**Explosive Arm Power**
Significant	8.75	2,42	62,5	2,66	55,5	Cm	**Explosive Leg Power**
Significant	6	0.13	3.86	0.78	4.88	Time/sec	**Transitional Speed**
Significant	6.40	2.08	35.43	2.20	31.14	**Number × Time**	**Arm agility**
Significant	6.2	2.76	41.37	2.33	36.41	**Degree**	**Shoulder flexibility**
Significant	9.3	0.61	4.20	1.3	5.13	**Time/sec**	**Agility**

*The value of the (T) table equals (2.02), at the significance level (0.05), and the degree of freedom (38). Table (9) shows that the differences between the results of the post-tests between the control and experimental groups were statistically significant in favor of the experimental group in the tests (explosive strength of the arms, explosive strength

of the legs, transitional speed, motor speed of the arms, shoulder flexibility, and agility). This confirms the positive effect of the intermittent training program for the experimental group and its superiority over the method followed by the control group, as follows:

•Explosive strength of the arms

The arithmetic mean value of the post-test for the explosive strength element of the arms for the control group was (401.16) cm and a standard deviation of (3.31). While the post-test arithmetic mean value for the experimental group was (418.66) cm and a standard deviation of (3.50). Since the calculated (T) value of (16.35) was greater than the tabular (T) value of (2.02). The difference was significant in favor of the experimental group at a significance level of (.05), A degree of freedom = (38), and Figure (21) shows the values of the arithmetic means for the post-test between the two groups in explosive strength of the arms.

• Explosive strength of the legs

The arithmetic mean of the post-test for the explosive strength of the legs for the control group was (55.5) cm and a standard deviation of (2.66). While the arithmetic mean of the post-test for the experimental group was (62.5) cm, and a standard deviation of (2.42). Since the calculated (T) value of (8.75) was greater than the tabular (T) value of (2.02). The difference was statistically significant in favor of the experimental group at a significance level of (0.05), A degree of freedom = (38), and Figure (22) shows the values of the arithmetic means of the post-test between the two groups in the explosive strength of the arms.

• Transitional speed

The arithmetic mean value of the post-test for the transitional speed element for the control group was (4.88) seconds and a standard deviation of (0.78). While the arithmetic mean value of the post-test for the experimental group was (3.86) seconds and a standard deviation of (0.13). Since the calculated (T) value of (6) was greater than the tabular (T) value of (2.02). The difference was significant and in favor of the experimental group at a significance level of (0.05), A degree of freedom = (38), and Figure (23) shows the values of the arithmetic means for the post-test between the two groups in the strength of the transitional speed.

- **Arm motor speed**

The post-test arithmetic mean for the arm motor speed test for the control group was (31.14) numbers per time, and a standard deviation of (2.20). While the post-test arithmetic mean for the experimental group was (35.43) numbers per time, and a standard deviation of (2.08). Since the calculated (T) value of (6.40) was greater than the tabular (T) value of (2.02). The difference was significant in favor of the experimental group at a significance level of (0.05), and a degree of freedom = (38). Figure (24) shows the post-test arithmetic mean values between the two groups in arm motor speed.

- **Shoulder flexibility**

The post-test arithmetic mean for the shoulder flexibility test for the control group was (36.41) cm, with a standard deviation of (2.33). While the post-test arithmetic mean for the experimental group was (41.37) cm, with a standard deviation of (2.76). Since the calculated (T) value of (6.2) was greater than the tabular (T) value of (2002). The difference was significant in favor of the experimental group at a significance level of (0.05), A degree of freedom = (38). Figure (25) shows the

values of the post-test arithmetic means between the two groups in shoulder flexibility.

- **Agility**

The arithmetic mean value of the post-test for the agility element for the control group was (5.13) seconds, and a standard deviation of (1.3). While the arithmetic mean value of the post-test for the experimental group was (4.20) seconds and a standard deviation (0.61). Since the calculated (T) value of (9.3) was greater than the tabular (T) value of (2.02). The difference was significant in favor of the experimental group under a significance level of (0.05), A degree of freedom = (38), and Figure (26) shows the values of the arithmetic means for the post-test between the two groups in agility.

Interpretation of the results

Results' Interpreting

It is clear from table (8) of the pre- and post-tests results for the experimental group that the results were in favor of the post-tests. This confirms the positive effect of the intermittent training program. The researcher attributes the development to the various exercises included in the training program that made the players exert physical effort mixed with elements of suspense away from The specialized game. The development of explosive power, transitional speed, motor speed, and agility came as a result of light and medium free resistance exercises, such as weight vests and weight jitters. It were carried out according to the performing method at maximum speed by throwing the body or tool into a vacuum which led to the stimulation of... the fast-twitch muscle fibers in the working muscles. This in turn was reflected in the development of physical fitness elements. In addition to the players applying foam roller exercises after every exercise and physical effort which led to the development of the flexibility element.

With reference to (Viaño-Santasmarinas et al., 2018), Adopting training through interval training with periods of high effort followed by periods of rest or low effort which helps improve physical performance Significantly. one of the most prominent benefits of interval training is improving aerobic and anaerobic capacity. By enhancing the efficiency of the cardiovascular system, players become able to endure high efforts for longer periods. They perform intense activities for short periods which is vital in team games that require repeated efforts from sprints and jumps. In addition, interval training enhances muscular endurance which helps players maintain their performance during long matches. In general, interval training is an effective tool for improving the basic elements of physical fitness in players which contributes to improving their performance in matches. Incorporating this type of training into physical preparation programs can have significant positive effects on the level of athletic performance. (Viaño-Santasmarinas et al., 2018, p. 12,13)

Table (9) the results of the post-tests between the control and experimental groups showed that the differences were in favor of the experimental group, which outperformed the control group that trained according to the training method followed. The researcher attributes this result to the effective impact of the training program designed by the researcher based on intermittent training and what it contains of various exercises and activities interspersed with foam roll-line exercises that are characterized by modernity among exercises with physical effort. The development achieved in the elements of physical fitness (explosive strength of the arms and legs, transitional speed, motor speed of the arms, flexibility, and agility) for the experimental group was the result of the content of the intermittent training program. Itis based on the use of training loads in a scientific manner of interval training with the use of intensity in a gradual and wavy manner. This situation contributed to establishing an

appropriate amount of strength, speed, flexibility, and agility, which was reflected in the high level of physical elements. The researcher also believes that this result in favor of the experimental group could be due to the complex interaction between the physiological, psychological and training factors that affect the players when practicing intermittent training. In addition to integrating swimming, stationary running and cycling exercises into the intermittent training program which raised the players' level. The experimental group also practiced intermittent training that included periods of activity with rest periodsthat through this diversity in training.The athletes become accustomed to endurance and sustainable physiological response which helps the body adapt to these different conditions, making them more capable of endurance and adapting to the requirements of the basketball game . Therefore, intermittent training provides an opportunity to stimulate different physiological responses in the bodywhich enhances the flexibility of the players and their ability to adapt various conditions during matches. This can lead to superior performance and achieving positive results in sports confrontations. (Larry & Wilmore, 2012) confirm that intermittent training means training in more than one sport at the same time. Or it is training different elements of physical fitness such as strength, endurance, and flexibility at the same time, as players train with a group of resistance training, weights, swimming, running, and cycling for the purpose of preparing for competitions and sports championships. (Larry & Wilmore, 2012, p. 248)

Conclusions

-The training program based on intermittent training has a positive effect on the development of physical fitness elements among students of the College of Physical Education in Iraq.

-The training program based on intermittent training for the experimental group had an advantage over the training method followed the control group in developing physical fitness elements among students of the College of Physical Education in Iraq.

Recommendations

-The importance of taking the results of the current study adopting them as a source for developing physical fitness elements among students of the Colleges of Physical Education in various Iraqi universities.

-The necessity of paying attention to the training method using intermittent training as one of the modern methods in training. While being keen to employ its various activities with the aim of developing various physical and psychological qualities among players of Iraqi university teams in various games.

-The necessity of enhancing the capabilities of coaches of the Colleges of Physical Education teams in various events by enhancing continuous training programs and workshops to develop their skills and knowledge in various sports fields. As well as encouraging the continuous exchange of knowledge and experiences between coaches from various sports to ensure the development of the capabilities of coaches supervising the teams of the Colleges of Physical Education when using the intermittent training program.

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