



The effects of CrossFit training on the development of some elements of physical and functional fitness and the level of performance on the floor movement apparatus

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Abstract

This research aims to identify the training effects of CrossFit in developing some elements of physical and functional fitness and the level of performance on the floor movement apparatus in accordance with the amendments to the international law for men's gymnastics .

The basic study was applied to a deliberate sample of first-class artistic gymnastics players registered with the Egyptian Gymnastics Federation, and enrolled in the Military Institution Club in Alexandria, numbering (8) players. The experimental approach was used for one group to suit the nature of the research, as the experimental group underwent a training program for CrossFit, and the experiment continued. For a period of (12) weeks, (36) training units, (3) weekly training units.

Conclusions :

- *The use of crossfit training led to the improvement of some elements of physical and functional fitness among the first-class artistic gymnastics players.*
- *The use of crossfit training led to an improvement in the level of skillful performance on the ground movement apparatus.*

Recommendations :

- *The application of crossfit training to improve the elements of physical and functional fitness and the level of skillful performance of first-class artistic gymnastics players.*
- *Conducting similar studies to find out the effect of crossfit training on various sports activities*
- **Keywords :** (CrossFit - Physical and functional fitness - Ground movement)

Introduction:

Scientific progress in sports training, starting from the preparation of young people until they reach high levels, does not come by chance. (Hassan, 2010, p 8)

Every sporting activity has physical requirements, physiological and psychological characteristics, and special preparations that distinguish it from other activities. These requirements are reflected in the qualities that must be possessed by those who practice this activity. The player's chances of success increase when these requirements are met, and championship is achieved when the scientific method is applied in training, nutrition, health care, social and psychological care. (Al-Jabali, 2003, p 477)

Artistic gymnastics is one of the sports activities in which the performance level of players reaches the highest levels, and this was clearly demonstrated in the Olympics and world championships. This depends on the development of special physical fitness elements and the appropriate use of the body's muscle groups, whether large or small, to suit the relatively permanent change in diversity. Progress in motor skills and an increase in the technical level requires

continuous work and diverse, innovative and effective methods to develop the elements of special physical fitness and raise the level of technical performance of motor skills. (Abdel Latif, 1994, p 14)

The skill performance on the ground movement apparatus is characterized by the diversity in the nature of the skills, and the different requirements of the technical performance, and this is demonstrated by the movement groups of the ground movement apparatus, which consist of (non-acrobatic skills, front acrobatic skills, back acrobatic skills, lateral acrobatic skills, or with a half-roll backward with... Frontal acrobatic skill around the transverse axis (ends).

It is also possible to link between skills in sequence, and this link can be made between the simplest skills up to the most complex skills, and the link can be between frontal skills and between front and back skills, as the nature of performance may differ when performing a single skill or linked to another skill. (Habib, 2000)

The Technical Committee of the International Federation of Gymnastics (FIGTC) is seeking to amend the international arbitration law for motion sentences, and it is natural that

the level of performance in general will be affected negatively until adaptation takes place with these amendments through the development of training programs. (Fink, 2000) , (Amin,2022 , p 105)

The amendments to the ground movement device law were as follows:

- Modifying the evaluation method by separating the evaluation and composition of dynamic sentences from the performance evaluation by dividing the evaluation factors into (E) and (D) committees.
- Formation of the arbitration committees in the official championships of the International Gymnastics Federation from the Referees Committee (D) with 2 referees, and the Referees Committee (E) with 6 referees.
- Increasing the deductions values by allocating (10) degrees to the referees, within the limits of which the deduction is made when (formal errors, technical errors) occur.
- Raising the deductions for various errors (0.1 for a simple error, 0.3 for a medium error, 0.5 for a major error, and 0.8 for a fall during performance). (International Gymnastic Federation, 2006)
- Cancellation of all air rotations that end with roll or rolling movement.
- Eliminate the fourth group of lateral aerobic movements and include their skills between the second and third groups, the front and back rotations.
- Limiting the number of force movements to a maximum of two.
- Limiting the movement of flanges or Thomas with a maximum of two movements.
- Canceling the performance of the chain of movements on the same line more than two times.
- It is obligatory to have two air circuits around the transverse axis, in front or behind, for first-class players.
- Raising the value of moves from difficulty G to difficulty H. (International Gymnastics Federation ,2017, p 41).

CrossFit is one of the modern exercises in exercises, as it is a variety of different exercises that start first with a warm-up, and then basic exercises such as abdominal exercises, running, aerobic exercises, pull-ups, weightlifting, gymnastics, Swedish exercises and rowing, and are performed individually or collectively. (Cross fit, inc-founder, 2002, p 3

Its importance becomes clear in quick teaching and improving the level of skill performance, which allows the individual to quickly master complex technical aspects and perform them easily. It contains static and movement positions that help achieve muscular and physiological efficiency and control the direction of movement. (Al-Sayed, 2006, p 361)

Skill performance is closely linked to the elements of physical fitness and specific movement, and its mastery depends on the extent of development of these elements, which vary from one activity to another according to the requirements of this activity in order to achieve the desired goal. (Cross fit, inc-founder, 2002, p 65)

From the above, the difficulties and problems facing artistic gymnasts are clear as a result of the amendments that negatively affected the evaluation of the level of performance of movement movements, which prompted researchers to know the effect of CrossFit exercises in improving some elements of physical and functional fitness and the level of performance of artistic gymnasts in accordance with the amendments to the law of the floor movement apparatus.

Research Objective:

Identify The effects of CrossFit training on the development of some elements of physical and functional fitness and the level of performance on the floor movement apparatus according to the amendments to the international law for men's gymnastics.

Research hypotheses:

- There are statistically significant differences between pre and post measurements of the experimental group in some elements of physical and functional fitness, in favor of the post measurements.
- There are statistically significant differences between pre and post measurements of the experimental group in the level of performance in performance on the ground movement, in favor of the post-measurements.

Search procedures:

Research Methodology:

Experimental approach with one experimental group design used due to its relevance to study nature.

The human domain:

Player's gymnasts registered with the Egyptian Gymnastics Federation and registered in the Military Institution Club, first class

Time domain:

The study was conducted from 5/3/2023 to 23/6/2023 as follows:

1. Pilot studies conducted in the period from 5/3/2023 to 17/3/2023.
2. Premeasurements conducted in the period from 19/3/2023 to 24/3/2023.
3. The basic study was conducted from 26/3/2023 to 16/6/2023.
4. Post measurements conducted in the period from 18/6/2023 to 23/6/2023.

Spatial domain:

Military Institution Club - Physiology Laboratory of Physical Effort, Faculty of Physical Education for Girls, Alexandria University

Human domain:

Player's gymnasts registered with the Egyptian Gymnastics Federation and registered in the Military Institution Club, first class, and they numbered (8) players.

Pilot studies:

First pilot study:

Aimed to

Selection and identification of the most appropriate tests and good, functional measurements.

This study resulted in:

• **Physical and physiological tests and measurements:**

1. hand grip strength (kg) to measure maximum strength. (Hassanin, 2005)
2. broad jumping from standing (in cm) to measure muscle strength. (Allawi and Radwan, 2001)
3. ball push test (5 kg) (in meter) to measure speed power. (Hassanin, 2005)
4. Push-up (by number) to measure muscle endurance. (Hassanin, 2005)
5. 800 m run test (in minutes) to measure anaerobic endurance. (Janssen, 2001)
6. 1500 m run test (in minutes) to measure aerobic endurance. (Janssen, 2001)
7. 30 m sprint test (in seconds) to measure speed. (Hassanin, 2005)
8. Trunk tuck (in cm) to measure range of motion. (Allawi and Radwan, 2001)
9. Push-up from standing 10 seconds (by number) to measure agility. (Allawi and Radwan, 2001)
10. Numbered circles test (in seconds) to measure coordination. (Allawi and Radwan, 2001)

11. Standing on the instep test to measure static balance. (Hassanin, 2005)

12. Modified bass test to measure motor balance. (Hassanin, 2005)

• **Physiological tests:**

Measuring respiratory functions using ergospirometre. (Everson, 2001)

- **Measurements in rest:**

1. Vital capacity (VC).
2. Expiratory reserve volume (ERV).
3. Inspiratory reserve volume (IRV).
4. Tidal volume (TV).
5. Inspiratory Capacity (IC).

- **measurements in effort:**

1. VO2max.
2. VO2 max/kg.
3. VCO2 max.
4. RER.
5. VE.

second pilot study:

Aimed to

Selection the exercises and design the training program using CrossFit.

Statistical treatments:

SPSS statistical program used to extract the following:
Mean - standard deviation - skewness coefficient - difference coefficient - Mean difference - T test - improvement percentage.

Homogeneity of the sample:

*Table (1)
Statistical significance of the main variables before the*

variables	statistics	measurement unit	Mean	Standard deviation	Skewness coefficient	difference coefficient
	Basic variables	Age	Year	19.72	2.15	2.54
Height		cm	168.22	4.42	1.96	2.63%
Weight		Kg	66.25	2.93	2.68	4.42%

Table (1) results reveal that skewness coefficient values ranged between (1.96) and (2.68), values between ± 3 and close to zero. Also, all values of the coefficient of variation are limited between (2.63%) to (10.90%), a value less than 20%, which indicates the homogeneity of the sample in all the main variables under consideration.

Table (2)
Statistical significance of the physical variables before the experiment

Statistical significance		Mean	Standard deviation \pm	Skewness coefficient	difference coefficient
variables					
maximum strength	hand grip strength (kg)	43.25	4.63	1.53	10.71
Muscle strength	broad jumping from standing (in cm.)	210.63	3.75	2.25	1.78
Speed power	ball push test (5 kg) (in meter)	10.86	1.22	0.36	11.23
Muscle endurance	Push-up (by number)	54.21	2.62	2.26	4.83
Cardio-respiratory endurance	800 m. run (in minutes)	3.37	54.0	0.75	16.02
	1500 m. run (in minutes)	6.48	0.79	1.65	12.19
Speed	30 m. sprint (in seconds)	3.45	0.18	1.14	5.22
range of motion	Trunk tuck (in cm.)	8.13	0.85	1.36	10.46
Agility	Push-up from standing (10 seconds) (by number)	26.67	4.27	2.24	16.01
Coordination	Numbered circles (in seconds)	2.59	0.24	1.38	9.27
static balance	Standing on the instep (in seconds)	10.67	1.57	0.62	14.71
motor balance	Modified bass (in seconds)	8.87	0.68	1.32	7.67

Table (2) results reveal that skewness coefficient values ranged between (0.36) and (2.26), values between ± 3 and close to zero. Also, all values of the coefficient of variation are limited between (1.78%) to (16.02%), a value less than 20%, which indicates the homogeneity of the sample in all the physical variables under consideration.

Table (3)
Statistical significance of the functional variables before the experiment

Statistical significance		Mean	Standard deviation \pm	skewness	difference coefficient
Variables					
In rest	Vital capacity (VC) (liter)	4.86	0.45	0.45	9.26
	Expiratory reserve volume (ERV) (liter)	1.64	0.09	1.35	5.49
	Inspiratory reserve volume (IRV) (liter)	2.93	0.07	2.66	2.39
	Tidal volume (TV) (liter)	0.96	0.15	1.65	15.63
	Inspiratory Capacity (IC) (liter)	3.89	0.23	2.37	5.91
In effort	VO ₂ max (L/min)	3.79	0.26	0.12	6.86
	VO ₂ max (ml/minute//kg)	43.36	1.59	0.09	3.67
	VCO ₂ max (L/min)	3.02	0.35	1.17	11.59
	RER	1.86	0.12	2.12	6.45
	VE (L/min)	77.23	5.23	1.36	6.78

Table (3) results reveal that skewness coefficient values ranged between (0.09) and (2.66), values between ± 3 and close to zero. Also, all values of the coefficient of variation are limited between (2.39%) to (15.63%), a value less than 20%, which indicates the homogeneity of the sample in all the functional variables under consideration.

Table (4)
Statistical significance of the skill performance level before the experiment

Variables	Statistical significance	Mean	Standard deviation \pm	skewness	difference coefficient
	Skill performance level (mark)		8.02	0.32	0.65

Table (4) results reveal that skewness coefficient value (0.65), values between ± 3 and close to zero. Also, value of the coefficient of variation are limited (3.99%), a value less than 20%, which indicates the homogeneity of the sample in the level of skill performance under consideration.

Main experiment:

- The experimental group underwent a training program using CrossFit exercises.
- The increase in the load through the gradual increase in the load, the continuity.
- The experiment lasted for (12) weeks, (36) training units, with (3) weekly training units.
- Load and rest principle used as a training base.
- The duration of the training unit is (60-90) minutes.
- The number of training unit exercises (6), the average time of performing one exercise (30-45) seconds.

- Average repetitions (6-8), intensity (80-95%), number of sets (3-5), rest between sets (3-4 minutes)

Skill performance Evaluation:

The performance of the movement sentences of the boys' artistic gymnasts on the floor movement apparatus (Handspring, Forward somer sault straight, half forward somer sault straight) was evaluated by international judges and coaches, professors and experts from Faculty of Physical Education for Boys, Alexandria University.

Results and discussion:

Results:

Table (5)
Statistical significance of the pre and post measurements of the physical variables for the total research sample

Statistical significance variables		Pre measurement		Post measurement		Mean difference	T value	improvement percentage %
		Mean	Standard deviation \pm	Mean	Standard deviation \pm			
maximum strength	hand grip strength (kg)	43.25	4.63	54.33	9.06	-11.27	3.63*	26.16
Muscle strength	Broad jumping from standing (in cm.)	210.63	3.75	215.45	3.35	4.82	6.166*	2.29
Speed power	ball push test (5 kg) (in meter)	10.86	1.22	14.21	1.19	3.35	8.25*	30.85
Muscle endurance	Push-up (by number)	54.21	2.62	59.53	3.12	5.14	4.16*	9.48
Cardio-respiratory endurance	800 m. run (in minutes)	3.37	54.0	2.943	0.268	0.364	5.375*	11.01
	1500m. run (in minutes)	6.48	0.79	6.227	0.088	0.231	7.612*	3.58
Speed	30m. sprint (in seconds)	3.45	0.18	3.297	0.036	0.193	6.456*	5.59

range of motion	Trunk tuck (in cm.)	8.13	0.85	12.80	1.15	4.67	15.52*	57.38
Agility	Push-up from standing (10 seconds) (by number)	26.67	4.27	31.73	4.01	5.07	12.79*	19.00
Coordination	Numbered circles (in seconds)	2.59	0.24	2.21	0.11	0.38	6.61*	14.67
static balance	Standing on the instep (in seconds)	10.67	1.57	18.52	2.68	7.85	5.96*	73.57
motor balance	Modified bass (in seconds)	8.87	0.68	15.48	2.24	6.61	14.22*	74.53

* Significant at 0.05 level (T significant = 2.365)

Table (5) of the statistical significance of the physical variables under study between the pre- and post-measurement of the experimental group, it is clear that there are statistically significant differences at the (0.05) level, where the calculated (T) value ranged between (3.63) to (15.52) , which is greater than the tabular value of (T) , and the improvement rates ranged between (2.29) % and (74.53) % . And this is in favor of the post-measurement.

Table (6)

Statistical significance of the pre and post measurements of the functional variables for the total research sample

Statistical significance		Pre measurement		Post measurement		Mean difference	T value	improvement percentage %
		Mean	Standard deviation ±	Mean	Standard deviation ±			
Variables								
In rest	Vital capacity (VC) (liter)	4.86	0.45	5.25	0.17	0.39	12.74*	8.02
	Expiratory reserve volume (ERV) (liter)	1.64	0.09	1.93	0.053	0.29	6.54*	17.68
	Inspiratory reserve volume (IRV) (liter)	2.93	0.07	3.16	0.15	0.23	13.21*	7.85
	Tidal volume (TV) (liter)	0.96	0.15	1.26	0.06	0.3	16.45*	31.25
	Inspiratory Capacity (IC) (liter)	3.89	0.23	4.09	0.18	0.2	12.24*	5.14
In effort	VO2max (L/min)	3.79	0.26	3.98	0.58	0.19	7.25*	5.01
	VO2 max (ml/minute//kg)	43.36	1.59	47.63	1.67	4.27	12.12*	9.85
	VCO2 max (L/min)	3.02	0.35	3.56	0.56	0.54	8.63*	17.88
	RER	1.86	0.12	2.09	0.16	0.23	5.45*	12.37
	VE (L/min)	77.23	5.23	89.18	5.88	11.95	7.12*	15.47

* Significant at 0.05 level (T significant = 2.365)

Table (6) of the statistical significance of the functional variables under study between the pre- and post-measurement of the experimental group, it is clear that there are statistically significant differences at the (0.05) level, where the calculated (T) value ranged between (5.45) to (16.45) , which is greater than the tabular value of (T) , and the improvement rates ranged between (5.01) % and (31.25) % . And this is in favor of the post-measurement.

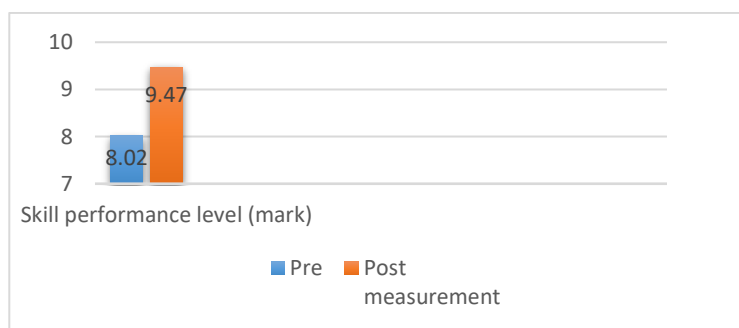
Table (7)
Statistical significance of the pre and post measurements of the skill performance level for the total research sample

Statistical significance Variables	Pre measurement		Post measurement		Mean difference	T value	improvement percentage %
	Mean	Standard deviation ±	Mean	Standard deviation ±			
Skill performance level (mark)	8.02	0.32	9.47	1.49	1.45	10.36*	18.08

* Significant at 0.05 level (T significant = 2.365)

Table (7) of the statistical significance of the skill performance level under study between the pre- and post-measurement of the experimental group, it is clear that there are statistically significant differences at the (0.05) level, where the calculated (T) value (10.36), which is greater than the tabular value of (T), and the improvement rates ranged between (18.08) %. And this is in favor of the post-measurement.

Figure (1)
Statistical significance of the pre and post measurements of the skill performance level for the total research sample



Discussion:

statistically significant differences in the elements of physical and functional fitness between pre- and post-measurements due to the nature of the proposed program using CrossFit training, which has its importance in the speed of teaching and developing the level of skillful performance, which allows the player to quickly master complex technical aspects and perform them easily. Which contains fixed and dynamic positions that contribute to the individual's ability to improve and upgrade the level of skillful performance of many movements and positions in most sports activities, in addition to achieving muscular sufficiency and controlling the direction of movement. (Ibrahim, & Hassan, 1999, p 361)

CrossFit training is one of the modern methods of exercise. It is a group of different and varied exercises that start with warm-up and basic exercises (stomach, running, aerobics training, pull-ups, weightlifting, gymnastics, Swedish exercises), and it can be practiced without devices individually or collectively. Its most important features are

improving physical capabilities and protecting the body from injuries. (Wiksten, 1998, p 3)

Practicing sports activity, especially endurance training, leads to an increase in vital capacity, as the player needs an amount of air to extract the largest amount of oxygen from it to increase the volume of blood, which leads to the strength of the chest muscles, an increase in the rate of breathing and a depth in blood circulation. (Parker, 2006), (Salama, 2008, p 202)

sports training improves the functioning of the respiratory muscles and the safety of the respiratory passages (Heshmat, Salah El-Din, 2009, p 53), endurance training, especially, leads to an increase in the strength of the breathing muscles, and then improves the respiratory functions. (Celli, 1997, p 291)

The measurement of maximum oxygen consumption is used as an objective measure of the level of functional fitness. And to determine the effect of different training loads and the player's physical efficiency according to his ability to absorb, transport and use oxygen in his muscles, and that measurement alone can give an indication of the

functional state of the circulatory and respiratory systems. (Ibrahim, & Nofal, 1993, p 28)

aerobic exercise improves the maximum absolute oxygen consumption, the maximum relative oxygen consumption, the gas exchange coefficient, and the maximum pulmonary ventilation, as a result of improving lung function, heart rate, and the difference between arterial and venous oxygen. (Abdel Samie, 2005, p 87)

Anaerobic exercises lead to an improvement in the functions of the lungs by increasing the strength and endurance of the muscles between the ribs and the muscles of the diaphragm, improving the volume of breathing air (TV), and increasing the ability of the muscles to push air out of the lungs and thus increasing the vital capacity. (Hayes, 1998, p 6, 50)

High-intensity training has an effect on improving respiratory efficiency faster than low-intensity training, and increases endurance capacity, maximum absolute oxygen consumption, maximum relative oxygen consumption, and maximum pulmonary ventilation. (Tomlin & Wenger, 2001, p 1)

sports training has positive effects in improving respiratory functions (maximum absolute oxygen consumption, maximum relative oxygen consumption, pulmonary ventilation, reducing the number of breathing times required to move the same amount of air before training, and increasing the capillary surface, which results in increased gas exchange. (Sharkey, 1997, p 89, 90), and this was confirmed by the results of many studies (Ramadan, 2001), (Abdel Samie, 2005), (Mohamed, 2007).

Respiratory functions improve under the influence of sports training, as the volume of breathing air that is inhaled in one cycle (TV) increases, and the resistance to air flow decreases, which facilitates gas exchange. (Prentice, 1997, p 114)

This achieves the first hypothesis, where there are statistically significant differences between the pre and post measurements of the experimental group in some elements of physical and functional fitness under study in favor of the post measurements.

The differences with statistical indications between the pre and post measurements of the experimental group in the physical and functional variables and the level of skill performance and in favor of the post measurements are due

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to the nature of the proposed program using CrossFit training. Developing the requirements of this performance in terms of physical and motor capabilities to achieve the desired goal (Cross fit, Inc-Fonder 2002, p 65).

Also, the use of CrossFit training may help to develop physical and skill capabilities, which in turn helps to improve the level of performance on the ground movement apparatus. The limited flexibility in a joint and the shortness of the muscles working on this joint lead to a lower range of motion and thus a loss of strength and speed. (Al-Khatib, Al-Nimr, & Sukari, 1997, p 23-25)

The improvement in the level of performance on the ground movement machine is also due to the effectiveness of CrossFit training and the different activities it includes, and it works in the same direction as muscular work. Training the players in a varied and variable way prevents boredom and monotony, joint fatigue and prevents injury as much as possible, so the coach must take into account The benefit of one exercise is very limited, and to obtain the best results, training must be done with diversifying and changing the positions and angles of the player's body (Labib, 2008, p160)

This achieves the second hypothesis, where there are statistically significant differences between the pre and post measurements of the experimental group in the level of performance on the ground movement apparatus in favor of the post measurements.

Conclusions:

- The use of CrossFit training led to the improvement of some elements of physical and functional fitness among the first-class gymnastics' players.
- The use of CrossFit training led to an improvement in the level of skillful performance on the ground movement apparatus in accordance with the amendments to the international law for men's gymnastics among the first-class gymnastics' players.

Recommendations:

- Application of CrossFit exercises to improve the elements of physical and functional fitness and the level of skillful performance of first-class gymnastics players.
- Conducting similar studies to find out the effect of CrossFit training on different sports activities.

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