The Effect of Cross Fit Training on Specific Physical Fitness Components and the Performance Level of the Snatch Technique in Weightlifters

Prof. Dr. Mohsen Ali Ali Abu Al-Nour
Emeritus Professor at combat& Individual Sports– Faculty of Sport Science– Minia University
Asst. Lect. Mohamed Hany Hassan Kamel
Assistant Professor Individual Sports– Faculty of Sport Science– Minia University

- **Introduction: Research Problem**

Achieving success in regional and international sporting arenas has become a hallmark of national prestige, prompting advanced countries to allocate substantial budgets to their athletic programs in the belief that sporting victories reflect broader societal progress. Moreover, reaching elite competitive levels signifies both technological and social advancement.

Sporting preparation is fundamentally an educational process aimed at elevating the athlete to peak performance. This process rests on three interdependent dimensions—the athlete, the training regimen, and the coach—with the athlete's individual characteristics and motivations determining both their willingness and capacity to engage with and sustain the training program (8 : 35).

In Olympic weightlifting, developing the specific physical fitness components underlying the snatch lift is the primary pathway to high performance. General preparatory training fosters overall physical development by engaging muscle groups not directly involved in the competition movement, while subsequent specialized preparation targets the prime movers and the direction of muscle action required by the snatch.

This structured progression culminates in the refinement of technical execution.

Weightlifting, characterized by maximal force production under rapid and sustained effort, relies on rigorous training with heavy loads and precise technique to enhance both neuromuscular function and strength capacity (13 : 15). The snatch in particular depends on a combination of maximum strength, speed, strength–endurance, and flexibility, alongside psychological factors; balanced development of these attributes is essential for optimal performance (14 : 167).

Traditional training methods, however, often yield only modest improvements in these key capacities and the numeric (quantitative) performance level of weightlifters. To address this limitation, a regimen of exercises that mimic the directional and biomechanical demands of competition lifts is necessary (7 : 75).

Specific physical fitness components serve as the primary contributors to snatch performance, forming the foundation for setting new records and achieving competitive superiority. Their development hinges on comprehensive strengthening of all muscular qualities, with particular emphasis on those most critical to the lift (21 : 48).

The researchers contend that snatch training should involve a high volume of rapid repetitions, with brief inter-set rest periods to simulate the physiological demands of competition. Consequently, weightlifting performance is heavily dependent on speed-strength capabilities. Exercises that replicate the muscle actions and movement patterns of the snatch-such as those found in Cross Fit training-should be integrated into the program. Coaches must adopt scientifically grounded periodization and load-management strategies, as any misstep in training design can adversely affect performance, and improvements ultimately rest on the athlete’s response rather than the prescribed protocol alone (6 : 69).

Finally, the snatch is one of weightlifting's most technically demanding events, pitting maximal strength against an unmoving external load. Training must therefore aim to elevate the athlete's physical capacities—especially speed-strength—in concert with technical skill. A diverse array of Cross Fit-style workouts, delivered in a competitive environment, offers a potent stimulus for advancing both the physical and quantitative performance levels of weightlifters.

Research Aim :

This study aims to investigate the effects of a proposed Cross Fit-based training program on:

1- The level of selected specific physical fitness components related to the snatch technique in Olympic weightlifting.

2- The quantitative (numerical) performance level of the snatch in Olympic weightlifting.

- Research Hypotheses :

1- There are statistically significant differences between the pre- and post-test measurements of the experimental group in the specific physical fitness components, in favor of the post-test.

2- There are statistically significant differences between the pre- and post-test measurements of the experimental group in the snatch performance level, in favor of the post-test.

- **Definitions of Terms :**

Cross Fit Training:

Defined as constantly varied functional movements performed at high intensity, Cross Fit combines elements of aerobic training, bodyweight exercises, and Olympic weightlifting techniques (16 : 3).

Research Methodology and Procedures:

The researchers adopted the experimental method using a one-group design based on pre- and post-testing.

- **ResearchSample**

The research sample was purposefully selected from weightlifting students in the fourth year of the Faculty of Sports Sciences who are officially registered with the Egyptian Weightlifting Federation for the academic year 2024. The basic experimental sample consisted of 5 athletes, while the pilot sample included 10 athletes.

- **Homogeneity of the Sample** :

Homogeneity was verified among the 15 participants (main and pilot samples) in the variables of age, height, weight, training age, specific physical fitness components related to weightlifting, and the snatch performance level.

Table (1)

Mean, Standard Deviation, Median, and Skewness Coefficient for Age, Height, Weight, and Training Age of the Research Sample Individuals

Statistic / Variables		Unit of Measurement	Mean	Median	Standard Deviation	Skewness Coefficient
Growth Rates	Chronological Age	Month	20.39	20.14	0.620	-0.15
	Height	Cm	166.87	165.01	6.38	0.33
	Weight	Kg	87.33	88.02	6.53	-0.3
	Training Age	Year	5.4	5.04	0.51	0.44

It is clear from Table (1) that the values of the Skewness coefficient ranged between (±3), where the lowest Skewness coefficient value was (-0.15) and the highest was (0.44), indicating homogeneity among the sample individuals in age, height, weight, and training age.

Table (2)
Mean, Standard Deviation, Median, and Skewness Coefficient in Special Physical Tests and Numerical Level of the Research Sample Individuals

Variables / Statistic			Unit of Measurement	Mean	Median	Standard Deviation	Skewness Coefficient
Physical Tests	Maximal Strength	Back Muscle Strength Test	Kg	58.32	59.03	9.32	-0.707
		Leg Muscle Strength Test	Kg	128.0	129.00	9.25	0.85
		Grip Strength Test (1)	Kg	29.63	28.00	6.02	1.55
		Grip Strength Test (2)	Kg	23.25	22.00	4.81	0.91
		Full Squat Test	Kg	125.00	130.00	12.76	0.93
	Strength Endurance	Muscle Load Intensity	Count	23.35	35.00	7.34	0.41
		Leg Flexor Muscles	Count	35.26	35.00	4.44	0.75
		YMCA Test	Count	34.42	34.00	8.08	0.65
		Back Muscles	Count	29.20	28.00	6.33	1.36
		Prone Position of Players	Count	39.54	34.00	1.61	0.97
		Sit-up from Lying Position	Count	26.83	24.00	5.46	0.61
	Related	Speed-Related Strength Endurance	Count	11.43	10.00	2.40	0.70
		Speed-Related Physical Strength	Count	16.50	14.00	3.88	1.02
		Snatch Power	Kg	66.34	65.00	9.62	0.63
Numerical Level		Snatch Skill	Kg	105	105	7.08	0.392

It is clear from Table (2) that the Skewness coefficient values ranged between (±3) in the special physical tests and the numerical level of the snatch skill under study, indicating homogeneity among the sample individuals in these variables.

Data Collection Tools:

The researchers identified the research variables as follows:

1. Basic Variables: (Age – Height – Weight – Training Age).
2. Maximal Strength Tests.
3. Isometric Maximal Strength Test:
    - Grip strength (right and left) using a dynamometer
    - Back muscle strength using a dynamometer
    - Leg muscle strength using a dynamometer

    (5:15), (2:20), (12:225).
4. Strength Endurance Tests with Weights:

    a) Endurance test for leg extensor and flexor muscles, YMCA bench press test, back muscle endurance test

    (15:22), (5:15), (9:164), (7:111).

    b) Hanging (muscle pull) endurance test by gripping from above, push-up test from the prone position (18:22), (17:32), (5:15), (9:177), (6:105).

    c) Sit-up endurance test (18:22), (17:32), (5:15), (9:171), (9:104).
5. Flexibility Test:
    - Trunk forward bending from standing position

    (6:106), (17:84), (14:85), (9:63).
6. Speed-Strength Test:
    - Snatch power test (19:91).
7. Speed-Strength Endurance Tests:

    a) Physical speed-strength endurance test

    b) Weighted speed-strength endurance test
8. Numerical Performance Measurements:
    - Snatch skill

Instruments Used in the Research:

- Legal weightlifting equipment
- Wall-mounted pull-up bar
- Magnesium bicarbonate (Mytrea)
- Dynamometer
- Stadiometer for height and weight measurement
- Grip dynamometer
- Mats
- Olympic weightlifting bar and legal set of plates
- Swedish bench
- Dumbbells (15 kg, 20 kg, 25 kg)
- Stopwatch
- Jump rope
- Measuring tape
- Abdominal workout device
- Wall-mounted pull-up bar
- Wooden box
- Weight plate holder

First Pilot Study:

The first pilot study was conducted during the period from October 6, 2024 to October 9, 2024 on a sample representative of the research population but outside the main research sample, with the aim of:

1. Ensuring the validity of the tools and equipment used.
2. Determining the intensity, repetitions, rest periods, and duration of training units.

The pilot study resulted in:

1. The tools and equipment were deemed valid.
2. Determination of appropriate intensity levels for Cross Fit exercises, number of repetitions per set and group, rest periods, and duration of training units.

Second Pilot Study:

The purpose of this study was to perform scientific procedures for the tests of speed-strength endurance using weights and physical speed-strength endurance. It was conducted during the period from October 13, 2024 to October 20, 2024, on a sample of 10 weightlifters from the research population but not part of the main sample.

The researchers did not conduct scientific validations for the remaining tests used in the research, as these tests had been previously used in several studies on similar samples and for the same age group.

First – Validity:

The researchers calculated the terminal comparison validity coefficient to test the significance of the statistical differences using the Mann-Whitney equation. The pilot sample of 10 weightlifters was divided into two groups to test speed-strength endurance using weights and physical speed-strength endurance, as shown in Table (3).

Table (3)

Significance of Statistical Differences Using the Mann–Whitney Test Between the First and Second Groups for the Test of Speed-Endurance Strength with Weights and Physical Speed-Endurance Strength

0 = N = N1

Statistics / Test	Unit of Measurement	Distinguished Group		Undistinguished Group		Calculated (Z) Value	Significance Level
		Mean Ranks	Rank Sum	Mean Ranks	Rank Sum		
Speed-Endurance Strength (Weights)	Number	8	40	3	15	-2.64	0.008
Speed-Endurance Strength (Physical)	Number	8	40	3	15	-2.91	0.009

Tabulated Z value at significance level (0.05) = 2

As shown in Table (3), there are statistically significant differences using the Mann–Whitney test in the tests of speed-endurance strength with weights and physical speed-endurance strength. The calculated (Z) value is less than the tabulated value, indicating statistically significant differences in favor of the second group. This confirms the validity of the tests under investigation.

Second – Reliability:

The researchers applied and reapplied the tests on a sample of (10) weightlifting players from the same population but outside the primary research sample, with one week between the two applications.

Table (4)
Correlation Coefficients Between Test and Retest Applications in Speed-Endurance Strength Tests Under Investigation

Sample size (n = 10)

Statistics / Tests	Unit of Measurement	First Application		Second Application		Correlation Coefficient (r)
		Mean (X̄)	SD	Mean (X̄)	SD	
Speed-Endurance Strength (Weights)	Number	10.00	0.81	9.70	0.83	0.835
Speed-Endurance Strength (Physical)	Number	11.00	0.81	14.10	0.45	0.784

Statistical significance level at (0.05) = 0.075

As illustrated in Table (4), the correlation coefficients indicate high reliability for both the speed-endurance strength with weights and physical speed-endurance strength tests, confirming their consistency and reliability.

Main Study:

The researchers conducted the main experimental procedure as follows:

- Pre-Test Measurement:

The pre-test measurements were conducted on the main research sample, assessing growth rates, static and dynamic maximal strength, strength endurance, strength endurance with weights, speed-endurance strength (physically and with weights), and the snatch skill digital level for weightlifting players. These measurements took place from **October 21, 2024, to October 22, 2024**.

Main Experimental Procedure:

The researchers implemented the main experimental procedure on the research sample from **October 27, 2024, to December 19, 2024**, over a period of eight weeks with three training sessions per week. The **special preparation phase** lasted five weeks, followed by a **pre-competition phase** of three weeks.

Proposed Training Program:

Table (5)
Formation of the Per iodized Load Cycle for the Proposed Training Program

Stage / Severity of pregnancy	Special preparation stage					Pre-competition stage		
	1	2	3	4	5	6	7	8
Maximum load								
Pregnancy								
Average load								
"Number of training sessions × duration = total training minutes per week"	3×90	3×120	3×150	3×120	3×150	3×120	3×150	3×90

Table (6)
Weekly Load Cycle Formation During the Training Program
Medium Load = 27N

Unity / Load Level	1	2	3	Load strength
Maximum Load				64%
High Load				55%
Medium Load				50%
Load Volume	90	100	110	

Table (7)
Structure of the Weekly Training Load Cycle During the Training Program
Average Load: 360

Unity / Load Level	1	2	3	Load strength
Maximum Load				84%
High Load				75%
Medium Load				65%
Load Volume	100	120	140	

Table (8)
Structure of the Weekly Training Load Cycle During the Training Program

Average Load: 450

Unity / Load Level	1	2	3	Load strength
Maximum Load				100%
High Load				90%
Medium Load				85%
Load Volume	130	150	170	

It is evident from **Table (5)** that the proposed training program consists of **eight (8) weeks**, divided into two phases:

a) Phase One: This is the **special preparation phase**, consisting of **five (5) weeks**.
b) Phase Two: This is the **pre-competition phase**, consisting of **three (3) weeks**.

The **per iodized load cycle** in the special preparation phase follows a **(4:1)** ratio, meaning **four weeks of high and maximum intensity**, followed by **one week of moderate intensity** .
In contrast, the **per iodized load cycle** in the pre-competition phase follows a **(2:1)** ratio, meaning **two weeks of high and maximum intensity**, followed by **one week of moderate intensity**.

Training intensity levels are defined as follows:

- **a)** Moderate: from **50% to 64%**
- **b)** High: from **65% to 84%**
- **c)** Maximum: from **85% to 100%**

From **Table (6)**, it is clear that the **weekly load cycle**, when the average load is **290 N**, follows a **(3:1)** ratio, meaning **two weeks of high and maximum load** followed by **one week of moderate load**. The total training volume per unit is indicated under each table.

From **Table (7)**, it is evident that the **weekly load cycle**, when the high load is **360 N**, follows a **(2:1)** ratio, meaning **two weeks of high and maximum load** followed by **one week of moderate load**. The training volume for each unit is shown under the table.

From **Table (8)**, it is shown that the **weekly load cycle**, when the maximum load is **450 N**, also follows a **(2:1)** ratio, with **two weeks of high and maximum load** followed by **one week of moderate load**, with training volume per unit detailed under the table.

Presentation and Discussion of Results:

Table (9)
Significance of the Statistical Differences in the Special Physical Fitness Components Using the Wilcoxon Signed-Rank Test Between the Pre- and Post-Test Measurements (N = 5)

Variables \ Statistics			Unit	No. of Signs	Rank Sum	Mean Ranks	Calculated Z Value	Significance Level
Physical Tests	Maximum Strength	Back Muscles Strength Test	kg	0	–	0	15.00	0
		Leg Muscles Strength Test	kg	0	–	0	15.00	0
		Grip Strength Test	kg	0	–	0	15.00	0
		Grip Muscles Strength Test	kg	0	–	0	15.00	0
		Knee Muscles Strength Test	kg	0	–	0	15.00	0
	Strength Endurance	Book Belt Test	count	0	–	0	15.00	0
		Leg Curl & Stretch Test	count	0	–	0	15.00	0
		Chest & Arm Muscles Test	count	0	–	0	15.00	0
		Back Muscles Endurance Test	count	0	–	0	15.00	0
		Inclined Push-Up Test	Count	0	–	0	15.00	0
		Sit-Up Test	Count	0	–	0	15.00	0
	Speed-Strength Endurance	Weighted Speed-Strength Test	Count	0	–	0	15.00	0
		Bodyweight Speed-Strength Test	Count	0	–	0	15.00	0
	Speed-Strength	Snatch Power Test	Kg	0	–	0	15.00	0
	Flexibility	Flexibility Test	Cm	0	–	0	15.00	0

It is evident from Table (9) that there are statistically significant differences in the results of the Wilcoxon Signed-Rank Test between the pre-test and post-test measurements for the research sample. These differences appear across all tests: static and dynamic maximum strength, strength endurance, weighted and bodyweight speed-strength, as well as flexibility.

The calculated **Z-values** for all variables were greater than the critical value at a significance level of (0.05), indicating the presence of statistically significant improvements in favor of the **post-test measurements** of the research sample.

Table (10)

Statistical Significance of Differences in the Performance Level of the Snatch Skill Using the Wilcoxon Test Between Pre- and Post-Test Measurements for the Research Sample

Variables	Unit	No. of Signs	Rank Sum	Mean Ranks	Z Value	Significance Level
		Negative	Positive	Negative	Positive	
Snatch Skill	kg	0	–	0	15.00	0

It is clear from Table (10) that there are statistically significant differences in the performance level of the snatch skill among weightlifters, as the calculated (Z) value exceeded the tabular Z value, indicating statistically significant differences in favor of the post-test measurement.

Discussion of Results:

From Table (9), it is evident that there are statistically significant differences in special physical fitness tests between the pre- and post-test measurements for the tested variables. The tabular Z value at a significance level of (0.05) is zero, which confirms the presence of statistically significant differences in favor of the post-test.

This aligns with what Wadie Al-Tikriti (2011) noted, that high-level athletic training is characterized by continuity, which is based on the body's adaptation to withstand the high effort exerted during training (p. 287).

The researchers believe that the observed improvements in the tested physical variables are consistent with the findings of Hanafi Mokhtar (1988), Owais Al-Jabali (2001), Mohamed Hassan Allawi (1994), and Khaled Zahran (1992), who stated that the snatch skill requires a high degree of muscular strength, particularly in the legs, back, and shoulder girdle, and that any training program should include strength development.

Furthermore, Khaled Qarni (1998), Ali Abu Al-Nour (2015), and Tomas & Roger (2000) emphasized the importance of flexibility exercises for weightlifters due to their vital role in strength development and injury prevention (references: 4:73, 6:69, 20:321).

Hence, the first hypothesis is confirmed, which stated:

"There are statistically significant differences between the pre- and post-test measurements of the experimental group in some special physical fitness components for weightlifters in favor of the post-test."

Also, from Table (10) regarding the statistical significance of differences in the snatch skill test results, we observe statistically significant improvements in favor of the post-test.

The researchers believe that the development in performance level is attributed to the improvement in maximum strength components and the use of varied intensities within the training program. This agrees with findings from Ali Abu Al-Nour (2015), Khaled Zahran (1992), and Mohamed Hassan Mohamed (2004), who confirmed that focusing on exercise quality enhances the motor performance components of the snatch skill in weightlifting.

Thus, the second hypothesis is confirmed, which stated:

"There are statistically significant differences between the pre- and post-test measurements of the experimental group in the snatch skill performance level in favor of the post-test."

Conclusions:

In light of the study objectives, hypotheses, research sample, methodology, and the applied tests and measurements, the researchers concluded the following:

1. Cross Fit exercises have a positive effect on the development of maximum strength.
2. Cross Fit exercises have a positive effect on developing speed-strength endurance.
3. Cross Fit exercises have a positive effect on developing strength endurance.
4. Cross Fit exercises have a positive effect on developing flexibility.
5. Cross Fit exercises have a positive effect on improving the snatch skill among weightlifters.

Recommendations:

1. Cross Fit exercises and modern training methods should be integrated into proposed training programs to enhance physical fitness components and improve performance levels in weightlifters.
2. Conduct similar studies targeting different age groups and apply them to other skills such as clean and jerk.
3. Educate coaches and athletes on the importance of training planning and ensuring the availability of required facilities and tools.
4. Conduct similar research in other sports activities and also on female weightlifters.

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