

## The effect of Plyometrics exercise on the body composition components of 100m sprinters

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### Introduction and research problem: -

The idea of body characterization occupied the minds of scientists since ancient times, and everyone sought to find the best classifications in the light of which bodies could be described, and these classifications depended mainly on the components of body composition, especially muscle tissue and fatty tissue, and divided body patterns accordingly to the three known patterns (skinny - muscular - fat), as well as on lists of height and weight in the characterization of the body and judging the degree of fitness and overall health.

Abdel-Fattah (2003) indicates that plyometric exercises are a new form of mobile muscle contraction, which has become popular in recent times to improve the ability to jump, This type of training uses the Stretch Reflex to record the process of recruiting more motor units, it also focuses on loading all the contractile and elastic components of the muscle, and the rapid elongation of the muscles before contraction leads to an increase in the force of contraction to produce a greater force. (2)

The Science of sports training has made remarkable progress as a result of the increased efforts of scientists to develop sports-related sciences by searching for the best ways and means to develop physical, physiological levels and dexterity. (2:13)

Plyometrics is one of the types of exercises that contribute to improving some elements of fitness, the most important of which is explosive strength. It is one of the progressive and effective training methods that are used in the development of explosive power of the muscles of the arms, torso, and legs. (3:22)

Plyometrics can be used either with or without equipment, with increased intensity in strength exercises up to (75%) of the maximum intensity of the player and in speed exercises ranging from (80-90%) while positive breaks between exercises for advanced players are within the range of (90-180) seconds when the pulse reaches between (110-120) pulse/minute. As for young people, the recommended positive rest periods for them range from (120-240) seconds, when the pulse reaches (110-120) pulse / minute. (6:124)

Athletics is one of the individual sports that depends on the aerobic and anaerobic system as the duration of the race in the 100-meter sprint is less than 30 seconds. From the foregoing, we note that athletics, in all its requirements, is a mixture of the need for aerobic and anaerobic ability, while plyometrics is among the recently used exercises in strength and speed development exercises, which are essential elements in the performance of 100-meter sprinters. (7)

Through the researcher's experience as a player and fitness coach for this event, they noted that there is a weakness in not using plyometrics to improve performance and achievement, and that the development of appropriate training programs for players leads to improving the physical, physiological level, and dexterity, as well as contributing significantly to the player's access to higher levels of the game, especially games that require top fitness levels, foremost of which is athletics, but especially sprinting events need the integration of fitness elements, especially strength and speed, because of their great importance to the runners who are almost outweighing one player over another in the same event, so it was necessary to search for a training method that increases their efficiency in the players, so I used the Plyometrics, which may add to a large extent some physiological changes for these players.

### **Study objectives:**

The research aims to realize the effect of plyometric exercise program on response of body components , by measuring: (weight - BMI - water ratio - muscle ratio - bone percentage - fat percentage - energy consumed daily)

### **Study obligations:**

There are statistically significant differences between the pre- and post-measurements in favor of the post-measurement in the components of body composition.

**Research terms: -**

- **Physiological fitness:** is the fitness of all the functions of the body and the efficiency of the work of all its devices. (2:26)
- **Anaerobic capacity:** is the ability to produce energy for a brief period of time without the need to use oxygen. (2:149)
- **Response:** Reactions that occur in internal organs in training for one time.
- **Plyometrics:** Activities that include a cycle of extension and contraction of the working muscle, which causes its flexibility and works to benefit the muscle from the mechanical energy resulting from the effect of extension, leading to greater strength and speed of performance.
- **Body composition:** The ratio of the human body's composition of fat to other components of the body. (2:315)
- **Body density:** Body weight relative to the body volume, expressed in grams per cm<sup>3</sup>.
- **Calory:** The unit of measurement of thermal energy required to raise the temperature of one kilogram of water by one degree Celsius under special conditions. (2:316)

**Procedures: -**

**The method used:** The researcher used the experimental method using the one-group design, to fit the sample of the study.

**Study group:** The study group is made up of 100-meter sprinters, all in Cairo governorate.

**Sample and selection characteristics:** The research sample was selected in the deliberate manner of 100-meter sprinters for the 2020/2021 sports season and the sample consisted of (15) players as a main sample of players registered in the Egyptian Athletics Federation, the researcher also used (11) players from outside the main research sample to conduct the survey, and players from the same research study group, whose ages range from 16 to the first degree, males (15 players from Al-Ahly club, a main sample - 11 players from Al-Jazira Youth Center as a survey sample).

The researcher calculated the moderation of the distribution and parity of the research sample in terms of (height - weight - body mass index- water ratio - muscle ratio - bone percentage - fat percentage - energy consumed daily)

**Data collection tools and methods:**

Previous studies have used various means, including interviews, questionnaire preparations, observation, scientific references, body composition component tests using pro care health center device.

**Preparing the program for implementation****Program objective**

The proposed program aims to develop the body components composition by using plyometrics for the 100-meter sprinters.

**Results of similar studies: -**

- Programs have an individual and collective character.
- The Comprehensiveness of the program's development of some measures of homogeneity.
- Determination of the time slot to suit search procedures.

**Program foundations**

- Objective selection.
- Time period.
- Determination of the program duration.
- Determination of the number of training times.
- The time of the training unit within the program.
- The program applies three units per week (Sunday, Tuesday, and Thursday) each week.

**Program implementation schedule**

- Preparation time for program application.
- The total time for the application of the program's axes and the transition from one level to another, which was set for a period of three months.
- The end period of the program, which is based on the emphasis on the improvement of the contestants in the components of body composition.

**Steps to implement the research experience: -****Survey Sample Study**

The researcher conducted an exploratory study in the period from 25/9/2020 to 10/26/2020 on the survey sample from within the research group and outside the main sample, which was (11) players, to ensure the validity of the devices and equipment used, and training of assistants to implement

measurements and identifying errors that could happen and trying to realize them when conducting the main study, and realizing the time required for the measurement process.

## **Main Sample Study**

### **Pre-Plyometrics measurements:**

The researcher conducted preliminary measurements of the main research sample of the experimental group in the variables under study on Monday and Tuesday corresponding (28,29/9/2020), on the track of the Olympic Center in The Maadi.

The researcher applied a form assessing the performance levels, prepared by the researcher on Wednesday, 30<sup>th</sup> of September 2020.

The researcher applied the proposed program to the research sample for a period of three months, from Thursday (1/10/2020) to Thursday (30/12/2020).

That was on (Sunday, Tuesday, Thursday) of each week at the rate of half an hour in one training unit before the start of the usual physical training program.

### **Post Plyometrics measurements: -**

The researcher performed the post measurements of the main research sample, in the variables under study on Saturday and Sunday 2,3/1/2021, at the Olympic Center in Maadi.

**Statistical treatments used:** The researcher used SPSS to calculate the following statistics:

Average arithmetic - standard deviation () - significance of differences t- test – improvement rates

## 4/1 Results: -

**Table (1)**  
**Indication of differences between Pre and post measurements of 100m sprinters in body composition components**

(N =15)

Variables	unit \ scaling	Pre		Post		differences	T	P (value)	Rate of improvement
<b>Weight</b>	kg	58.96	8.72	62.01	6.27	3.05	<b>-1.98</b>	0.07	<b>5%</b>
<b>BMI</b>	KG/ M <sup>2</sup>	19.48	2.15	20.33	1.51	0.85	<b>-1.69</b>	0.11	<b>4%</b>
<b>Fat percentage</b>	%	11.65	5.71	12.84	4.54	1.19	<b>-0.69</b>	0.50	<b>10%</b>
<b>Water ratio</b>	%	47.79	9.88	50.33	13.57	2.54	<b>0.73</b>	0.47	<b>5%</b>
<b>Muscle mass</b>	kg	42.57	6.27	44.63	4.82	2.06	<b>-1.11</b>	0.28	<b>5%</b>
<b>Bone weight</b>	kg	3.54	0.89	4.15	1.00	0.61	- <b>3.53*</b>	0.00	<b>17%</b>
<b>Energy consumed daily</b>	Calory	1687	<b>282.23</b>	<b>2143.93</b>	<b>479.75</b>	<b>456.93</b>	- <b>3.52*</b>	0.00	<b>27%</b>

**\*Indication at the value of (p) ≤ (0.05)**

Table (1) shows that there are statistically significant differences between pre and post measurements **of the sprinters in bone mass and energy consumed daily**, and there are no statistically significant differences between pre and post measurements **of the 100-meter sprint players in**

(weight - mass index - fat percentage - Water ratio - muscle weight), improvement rates are limited to 4%-27% .

### Results Discussion:

It is evident from Table (1) that there are statistically significant differences between the pre and post measurements in favor of the post measurements in (bone weight - energy consumed daily), where the (T) values calculated for these variables were all statistically significant at the significance level  $(p) \leq (0.05)$ . **The percentage of change for the physiological variables, which is bone weight (0.61%), energy consumed daily (456.93%),** while there were no statistically significant differences in the variables (**weight – body mass index - fat percentage – water ratio - muscle weight**).

The researcher believes that there has been an improvement in the skeletal system, which has calcium as a fundamental element as well as other mineral salts and their roles in maintaining balance of the vital organs functions of the body as well as supplying blood with salts, so then it is affected by pressures and influences befalling it like the rest of the body's parts and organs.

According to the National Osteoporosis Foundation in the United States, weight exercises and muscle-strengthening exercises build bone density, and weight exercises including both low and high-impact activities, also according to the foundation, high-impact aerobic exercises, which include aerobics, walking, jogging, or running, jumping rope, tennis, and climbing stairs, are important for strengthening bones. (13)

It is known that bones' mineral density increases with exercise and physical activities. However, the movement of bones' metabolism varies not only by type, frequency and intensity of sport and physical activity, but also by age and gender. With regard to the metabolic movement of bones showing high-energy exercise, it is assumed that the increase in bones' mineral density occurs by promoting bone formation, on another hand reports show that the bones' mineral density of endurance athletes such as marathon runners is lower than that of non-athletes' bones' metabolism in endurance exercises, bone resorption is temporarily enhanced after exercise, followed by enhanced bone formation.

Dr. Hinton's study also found that osteoporosis-related exercise during adolescence, young adulthood, and adulthood enhances bone density in adulthood, and furthermore, found that intense activity with a significant



positive effect during growth and adulthood is a key factor for future bone health.

Dr. Hinton's study added: "The most important lesson we can learn from if you were in good health, you should start with high-impact sports activities or resistance exercise to improve bone mineral density, and although activity during skeletal development is important, we have seen relationships between this physical activity and bone density at all ages" (14)

Salah Sayed (2000) indicates that sports training, especially plyometrics, is related to bones' mineral density, which requires a higher degree of physical attributes, and the most important of these qualities is muscular strength, so coaches focus on having the players gain them, and bone mineral density is related, as Chang(2009) and others highlighted, to muscular strength, as increasing muscular strength greatly affects the increase in bones' mineral density, and that practicing muscular strength exercises, high-impact exercises and weight-lifting exercises on the bones are necessary for good bone growth, the study's results showed the superiority of those who exercised sports than non-practitioners in bone mineral density. (4:99) (11:782)

Abd al-Rahman Abd al-Hamid Zahran (2005) agreed that in order for movement to take place, there must be complete coordination between three main systems: the muscular system, which is responsible for carrying out its tasks through its proper reception of the nerve signal, and the skeletal system, which works to support the limbs and the moving parts, at the same time its parts act as axes suitable for muscle contact. (5:45)

He also agrees with what David (1993) indicated: that physical exercises contribute to maintaining the muscles and bones' strength, and that the mechanical pressure on the bones as a result of motor activity leads to the deposition of calcium salts in bone cells, therefore, the amount of bone building depends on the degree of strength and frequency in occurrence. (12:67)

It is clear from the previous presentation that the bones' mineral density increased for sports practices considering the years of practice, and the results of the study agree with the study of Forster and others (2001), Medhat Qassim (2009) and Young Hao and others (2011). (8:63) (9:2) (10:3)

Cross-sectional studies show that athletes, especially those trained in strength, have greater bone mineral density than non-athletes, and that strength, muscle mass, and maximum oxygen uptake correlate with bone density.



Longitudinal training studies indicate that high-impact strength and endurance exercises increase bone density, and stress induction, the deformation that occurs in bones under pressure, may cause a higher level of formation and resorption inhibition during the natural bone remodeling cycle, or it may cause a direct activation of osteoblast genesis from a resting state, and an increase in bones' blood flow, depending on the loading state and bone properties.

Thus, the validity of the hypothesis is partially achieved, which states that “there are statistically significant differences between the pre and post measurements in favor of the post measurement in body components.”

### **Conclusions**

Considering the objectives of the research and within the limits of the sample and the results reached, the researcher concluded the following:

- The plyometrics training program contributed positively to increasing the weight of the bones.
- The plyometrics training program has contributed positively to increasing the energy consumed.

Recommendations: -

Based on the results of the research, the researcher recommends the following:

- Spreading awareness for those interested and those in charge of the training process in the field of track and field competitions using plyometric training programs.
- Establishing a classification that allows diversity in various competitions, which affects each of them separately, due to the field and track competitions characteristics (the mother of games).
- Recommending the application of similar programs to other activities that include, to some extent, the same skills, physical and physiological requirements.
- Activating the role of the psychologist in the various levels of training due to its importance in improving the levels of the competitors.
- The plyometric training method should be used, as it is suitable for intermediate and advanced athletes.
- The necessity of using the exercises laid down within the training program in this study to improve the basic motor abilities of the 100-meter sprinters.
- Reducing the usage of traditional training programs, re-designing other plyometric training programs with high efficiency.

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