

A COMPARATIVE STUDY OF THE AMOUNT OF FORCE EXERTED ON THE GROUND AND THE TIME OF PROPULSION IN THE VERTICAL AND HORIZONTAL JUMPING TESTS FROM STABILITY USING A FOOT SCAN DEVICE

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Introduction

The great development that sports events and games have witnessed in recent years has come as a result of harnessing allied sciences and their applications to increase the effectiveness of training and continuous objective evaluation of the programs and methods used in training. The elements of physical fitness are one of the most important pillars of training that receive the attention of coaches and researchers in order to reach the highest levels of athletic achievement. The researchers were keen to design and master objectivity to measure physical characteristics from time to time to ensure the validity of these tests and thus give real results that express the levels of players in various sports activities. The characteristic of explosive power is one of the important complex physical characteristics, which constitutes the most important factor in many sports events and games. The tests designed to measure explosive power are characterized by complexity, which may make their results inaccurate. The great development of science has helped a lot in the development of testing and measurement, which has been reflected in the development of achievement. Using advanced devices, we can judge objectively and conclusively without there being the slightest doubt about a particular matter. One of these devices is the Foot Scan device, which gives conclusive indicators. There is no doubt about the amount of time of pushing and the force exerted on the ground by the muscles of the legs, as well as determining the strengths and weaknesses of the feet. It is known that two of the most important tests for measuring the explosive power of the lower limb muscles are the vertical jump from a standstill and the horizontal jump tests. However, it is not known which of the two tests is the most appropriate and most expressive for measuring explosive power. Accordingly, the importance of research lies in identifying the most appropriate test for measuring explosive power. Muscles and using a Foot Scan device to judge objectively and scientifically about the most appropriate test without relying on personal opinions, judgments or personal experience, in addition to obtaining indicators of strength and time.

Research problem

It is known among those concerned and specialists in the field of physical education and sports sciences that the human being is not a solid formation, but rather is a number of parts stacked together in the form of a divine geometry in which the human being has no involvement. Geometric shapes take multiple sizes and shapes, some of which are affected by the environment

and others by genetics. Improving the level of performance is achieved by increasing theoretical and practical knowledge in the fields of testing and measurement, which is the test that shows the true level of the player, and through it errors can be detected and weak points and mistakes in the training process can be identified so that the coach can thus avoid them and take the correct direction throughout the training process. The problem of the research lies in that the two tests of vertical jump from a standstill and a horizontal jump from a standstill used to measure explosive force have been decades old without considering the possibility of adopting one without the other or using modern laboratory equipment that gives more accurate, honest and objective results by measuring the amount of force applied to the body. Earth and measuring propulsion time using kinematic analysis technique.

Research objectives

- Identify the variables of the force exerted on the ground and the propulsion time of the legs in the vertical and horizontal jumping tests from stability to measure the explosive power of the leg muscles.
- Comparison between the vertical and horizontal jumping tests from a standstill to measure the explosive power of the leg muscles as a function of the force exerted on the ground and the time of pushing the legs.

Research hypothesis

There are no differences between the vertical and horizontal stability jump tests to measure the explosiveness of the leg muscles as a function of the force exerted on the ground and the time of pushing the legs.

Areas of Research

- The human field: A sample of students from Al-Nisour University College/Department of Physical Education and Sports Sciences.
- Time frame: for the period from (3/4/2023) until (3/23/2023)
- Spatial field: Biomechanics and Physiology Laboratory / Ensour University College.

Theoretical studies

Muscular strength

Muscular strength is the most basic component of physical fitness, which gains special importance as it is the most important pillar on which most sporting activities are based. No game or event is devoid of one of the types of strength that constitute the basic element in that game. Both (Al-Bashtawi, Ismail, 2006) and (Al-Bashtawi and Al-Khawaja, 2010) It is the first component of physical fitness. More than thirty scientists agreed that strength precedes all other components. (Mahmood et al., 2023) They added that strength training gives great happiness to both the player and the coach because it leads to an apparent development of this condition. The characteristic and in a short time, and the type of force varies according to the external activity or game, (Mondher, H. A., &Khalaf, 2023) or confronting these resistances. He defined it (Marwan Abdel Majeed, 2002, 143) as “the maximum force that a muscle produces as a result of a single

muscle contraction.” There are many types. Of the strength and specificity of research. (Essam, F., &Shaboot, 2023)

Most competent sources confirm that muscular strength is represented by two aspects:

First, the physiological aspect: Strength physiologically means that it is an amount of force produced by a muscle or a group of muscles, and it is directly proportional to the size of the physiological cross-section of the muscle. The greater the size of the physiological cross-section of the muscle, the greater the muscle force, and the physiological force production depends on several factors, including:

1. The physiological cross-sectional area and size of the muscle.
2. Capillaries in the muscle.
3. Muscle type.
4. The force and time of muscle contraction.
5. The number of motor units involved in force production.
6. Oxygen consumption.

Secondly, the mechanical aspect: Force is a mechanical action that changes or attempts to change the form or kinetic state of the body, and depends on the quantity of force, its directions, its point of impact, and its line of action, as well as the angles of action of the force.

The importance of muscular strength

- It contributes to the completion of any type of physical effortIn all forms of sports, the percentage of its contribution to muscular strength varies according to the type of physical effort.
- It contributes to the assessment of other physical elements and characteristics, such as speed and stamina.

We are an important source in achieving sporting excellence in most sporting events.

Types of muscular strength

Explosive power

Explosive strength ranks first among physical abilities in most sporting activities, especially team games. It is defined as “the instantaneous ability to produce a muscle contraction in the fastest time and for one time.”

Explosive strength training

It is used to develop muscular ability (explosive force) and some basic exercises aimed at developing strength and speed, including repeated vertical jumps from a standstill. Accordingly, a person with high ability must possess the following:

- 1 High degree of muscular strength.
 2. High degree of speed.
- High degree of skill to combine speed and muscular strength.

Power characterized by speed

It is a composite of muscular strength and speed (speed The compound called (force characterized by speed), and the concept of strength characterized by speed comes as the ability

of a muscle or a group of muscles to produce the maximum force in the shortest time, as it is equal to force multiplied by speed. That is, force characterized by speed = force x speed).

Factors affecting muscular strength:

Most scientific sources confirm that “force is the force of muscle contraction” and that its production depends on factors including:

1. Physiological section of the muscle.
2. Nuclei of muscle fibers (white - red - common).
3. Stimulating muscle fibers.
4. Duration of muscle contraction.
5. Neuromuscular compatibility.
6. Self-confidence.

foots can device

The electronic foot scanner is one of the modern scientific devices in the world of sports. This device consists of a jumping platform with dimensions (50 cm Required data: First, you must enter some necessary information for the tester, including (name - age - weight - shoe size) so that the data is read correctly during the test. The device also gives a set of variables such as the force exerted on the platform in newtons for each of the ten parts of the foot (according to the program's division of the foot), and it also gives the total force exerted by the foot on the platform. The device also measures the amount of pressure exerted on each of the ten parts of the foot according to the program's division of feet (newtons per square centimeter (N/cm). In addition, it gives the time period from the beginning of the first foot touching the foot scanner platform to the moment the last part of the foot leaves the platform. The device also gives an image of the longitudinal and transverse axes of the foot and the dimensions in centimeters.

Research methodology and procedures

Research methodology

The method is the path that leads to the desired goal, or it is the invisible thread that connects the research from its beginning to its end in order to reach certain results (1), and many cases and phenomena cannot be studied except through a method that is compatible with the problem. As the nature of the problem is the basis upon which the study methodology is chosen, the researcher therefore adopted the descriptive method using the (survey) method as it is the appropriate method to solve the research problem and achieve its objectives.

Research sample

One of the things that must be taken into account in the field of research is choosing a sample that truly represents the research community, as it is “the part that represents the community of origin, or the model on which the researcher conducts the entirety and focus of his work.” The research sample was chosen intentionally from students of Al-Nisour University College, Department of Physical Education and Sports Sciences. The number of the study sample was (10) students, and the following table represents the specifications and homogeneity of the research sample.

Table (1)The homogeneity of the research sample is shown by the skewness coefficient for the variables under study

Torsion coefficient	standard deviation	Mediator	Arithmetic mean	measuring unit	Measurements
1.36614162	7.16162613	175.5	176.2	poison	height
0.44910201	6.43341969	73.5	75.5	kg	the weight
0.66402553	4.11096096	27	26.7	year	the age
0.47838199	1.13529242	43	42.8	lonliness	Foot size

Devices and tools used in the research

- Arab and foreign scientific sources.
- Balance.
- Metric tape measure.
- Smartphone camera (IPHONE)
- Drawing scale (measurement 1 meter)
- LAPTOP computer for data analysis (HP type)
- Foot scanner (FOOTSCAN)
- Data analysis program (KINOVEA)

Field research procedures

The exploratory experiment

The researcher conducted an exploratory experiment to prepare the research requirements, including tools and devices, and for the purpose of identifying the technology of the devices and tools and their working function, in a way that is commensurate with the nature, objectives and tests of the study, and to distribute tasks to the assistant work team, as well as to identify the suitability and accuracy of the tests under research.

Measurements and tests used in the research

- Measure height and weight.
- Vertical jump test from a standstill with arms swing (1)
- .The aim of the test is to measure the vertical explosive power of the legs.
- The unit of measurement is the centimeter.
- Tools: A blackboard fixed to the wall with its lower edge at a distance of (150) cm from the ground, and then increasing from (151-400) cm. (The blackboard was dispensed with and the distances were measured using the motor analysis program)

Performance Specifications

- From standing still, the tester swings the arms down and back while bending the torso forward and down and bending the knees.
- The tester tries to jump vertically as far as he can reach.
- The tester is given three attempts, and the best attempt is counted.

- Jumping is done from a standing position, not by taking a step.

Test management

- A recorder calls the rolls.
- Calculating grades: The laboratory grade is the distance difference between the center of gravity of the body in a standing position and the highest point it reaches while jumping, which can be obtained through the kinetic analysis program (Kinovea)

Main experimen

The researcher implemented the main experiment on Saturday, 3/11/2023, at 12 noon. In the Biomechanics and Physiology Laboratory in the Department of Physical Education and Sports Sciences, for one day, the camera was set up at a distance of 3 m and a height of 150 cm. The ages of the research sample, foot size, and height and weight measurements were recorded in a special form that had been prepared in advance for this purpose, after a number was given. The sequence for each sample member. The method of implementing the test was explained: vertical jumping from a standstill and horizontal jumping from a standstill for the purpose of its implementation by the research sample for the purpose of carrying out the experiment. This was followed by connecting the foot scan device to the computer and adjusting its location to suit the angle and direction of the photographic camera. The research sample was also photographed while performing the tests using a camera at a speed of (120 images/second), for the purpose of extracting the push time, height, and jumping distance using the motion analysis program (Kinovea)

Statistical methods

Use the following

- MS - EXCEL.
- SPSS statistical package to obtain results through laws:
- Arithmetic mean standard deviation
- Mediator . Torsion coefficient
- Test (T_TEST) for independent samples.

Presentation, analysis and discussion of the results

Show results

Table (2) It shows the arithmetic means, standard deviations, the calculated (t) value, and the significance of the differences

Between the vertical and horizontal jump tests of stability in the variables under study

Measurements	Torsion coefficient	standard deviation height	Mediator		Arithmetic mean		measuring unit	Measurements height
			1.36614162	7.16162613	175.5	176.2		
معنوي	0.000	the weight	0.44910201	6.43341969	73.5	75.5	kg	the weight
معنوي	0.003	the age	0.6640255	4.1109609	27	26.7	year	the age

			3	6				
معنوي	0.030	Foot size	0.4783819 9	1.1352924 2	43	42.8	lonliness	Foot size

Degree of freedom (10+10-2-18).

Significant at the error level (0.05) if the error level is smaller than (0.05)

Analyzing and discussing the results

It is clear from Table (1) that there are significant differences in the variables of distance, push time, and force applied to the ground between the vertical and horizontal jump tests. Significant differences were shown in favor of the vertical jump test in the variables of push time and the amount of force applied to the ground. (Moayed, A., Moayed, G., &Jawad, 2019)This indicates that the vertical jump test from a standstill is the best in terms of the value of the force achieved, as generating high force requires a very short time of propulsion, and this is what the results show, as the average propulsion time for the vertical jump was (0.180) seconds, while for the horizontal jump it was (0.228). It is a good time and within the general rates, which supports the absence of loss of elastic energy stored in the muscles and ligaments as a result of eccentric muscle work (the stage of bending the knee to prepare for the jump). In this regard, TalhaHossam El-Din et al. (1997) (1) mentions that the time of fulcrum (push It should be as short as possible (300-500 milliseconds) for two reasons:TalhaHossam El-Din and others: Scientific Encyclopedia on Training, 1st edition, Cairo, Dar Al-Fikr Al-Arabi, 1997, pp. 80-85.

- Reducing time means training to develop strength within a specific period of time.
- The cycle of stretching (lengthening) and shortening (S.S.C) will occur within normal limits, and thus the athlete will be able to make the most of the elastic energy generated by the muscles that work by lengthening (eccentrically).

This is consistent with what was stated by (Ahmed Akour - 2003) quoted from Gambetta 1989) that a muscle can show greater strength if it is stretched effectively before it is allowed to shorten, which leads to an improvement in the effectiveness of muscle work.

What was mentioned above indicates that vertical jumping is more difficult to perform than horizontal jumping and that it requires higher explosive energy in addition to great neural stimulation to recruit working motor units. (Tawfeq, A., & Jalal, 2023)The vertical and horizontal jump tests of stability are based on the forced stretching that occurs in the ligaments and muscles working on the thigh and knee joints (Mousa, A. M., &Kadhim, 2023) and the ankle as a result of the preparation movements of the eccentric muscle work, which is immediately followed by a voluntary action in which the muscle shortens (pushing upward or forward). (Central muscle action), which results in greater capacity as a result of energy storage in the muscles and ligaments during the process of extending them and emerging during central muscle contraction. In this regard, (Dirix, etal. 1988) stated that the increase in force generated from eccentric tension goes back to the origin of Chemomechanical origin) and this was proven by (Edmanetal 1978) as it was found that if the muscle is pulled after a maximum isometric

contraction, the force generated will increase (jawadkadhim, M., & Mahmood, 2023) The results of this study are consistent with the findings of the study (Al-Taie and Reham - 2012) in that the vertical jump test from a standstill gives greater significance for measuring the explosive strength of the muscles of the lower extremity than the horizontal jump test from a standstill. (Moayed, 2016)

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Conclusions and recommendations

Conclusions

- There are significant differences in the amount of push time and the amount of force exerted on the ground between the vertical jump and horizontal jump tests from a standstill, and in favor of the vertical jump test from a standstill.
- Performing the vertical jump test from a standstill was more difficult to perform than the horizontal jump test from a standstill.
- The vertical jump test from a standstill gives greater significance in measuring the explosive strength of the leg muscles than the horizontal jump test from a standstill.

Recommendations

- Use the vertical jump test from a standstill to measure the explosive strength of the leg muscles.
- Conducting studies and research on the muscles of the lower limbs in the vertical jump and horizontal jump tests of stability and movement.

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