



## Assessment of the muscular power index using infrared technology

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**Abstract:** This research aims at assessing the muscular power index using the infrared technology. The researcher used the descriptive curriculum in the survey method as it is appropriate for the research procedures. The research sample is consisting of 8 youths born in 2004 aged less than 14 years old. The researcher used the OptoGait equipment to measure the variables of the muscular power (the capability to jump) by using on the infrared technology (jumping three meters using three barriers). The variables are as follows: (1) Contact time. (2) Flight time. (3) Elevation of center of gravity. (4) Power. Used tests: (1) Squat Jump Left leg 5 times. (2) Squat Jump Right leg 5 time. (3) Double legs squat jump. The researcher found that the average level of players in the height of the center of gravity from the ground "the jump height" is 25.8 cm which is an average less than required as the high level of the same age is 39.87 cm (15.7 inches). The researcher recommended using modern technological equipment in measurements such as the OptoGait to guarantee the accuracy, objectivity and quickly results extract. The researcher also refers to the importance of developing and improving the muscular power programs by exercising the bolometric training and the lengthening and default cycle to apply the principle of specialization in training.

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**Keywords:** Muscular power; infrared technology; OptoGait

### 1. Introduction

The modern technology becomes always in race to improve and develop the athletic results and it also becomes compatible with athletic development, especially the competitive one, as it is considered one of the training means and mechanisms whether as tools to improve physical or artificial performance or as a tool of measurement to achieve the best results, it is clear in the obvious differences in results in different champions whether continental, universal or Olympic. As for the researchers, the modern technical and technological means enable the researchers to get accurate, objective and quick data and it ensure the appreciation, organization and leadership in the training process to achieve the required goals which is considered the main step to reach high athletic levels.

As a result of scientific development in the field of sports, there is a new device for the optical evaluation of sports movements or sports performance by using infrared technology. This new device is called OptoGait. The device consists of two parallel barriers each is a meter length, each one contains 96 LEDs, and one of them sends infrared rays and the other receive

them. We can double the lengths by adding other barriers. The device also has two cameras (one is in the front and the other is in the side) both works in conjunction with the player movement. This device allows us to re-watch the performance, analyze the results and comparing the player with himself in various measurements or with others if it is required, in addition to the drivers. The variables in measuring the period between connecting and disconnecting the infrared as a result of the player movements between barriers during running, walking or jumping can be reached. As a result, we can measure the flight time or the contact time of the player feet with the ground during performing groups of jumping with accuracy 1/1000 per a second. So, the program can measure and analyze data during performing different exercises in addition to the instant view of all graphs and statistical treatments for all performance variables.

Based on these principles, the program allows us to record the data and analyze the performance at the same moment which guarantees feedback from the coach to the player and helps him to change or modify the performance form and content and as a result

achieve the required performance faster and also data retrieval later and give us information about the percentages of muscle balance between both left and right leg in each of the performance variables, the contact time, flight time, flight distance, muscular power and the used area.



The muscular power is an important element in the sportive performance which requires the ability to push the body for a specific distance or the ability to throw the ball or the tool quickly for a specific distance or height. The ability to jump is one of the important references for the muscular power of the legs and the bottom. It is considered the corner stone for most movements and skills in sports such as basketball, volleyball and football. The trainers and the players should pay attention to the improvement of the ability to jump for the possible highest distance and keep the

distance in performing consecutive bounce movements as it happens in offensive or defensive follow-up positions or jump to cut the path of the balls. There are many other skills done by jumping even from inside or outside the bow 6.75 m. this skill requires the ability to jump high and also the ability to throw the ball accurately and quickly through the ring and also to use one leg to jump during performing the skill of throwing balls beside other skills.



In this regard, Amr Allah Albosaty (2014) refers to the necessity to establish and develop the muscular power as one of the requirements of achievement. Abo El Ela Abd El Fatah and Haitham Abd El hammed (2019) add that the ability is a vast resource for improving the speed of movements especially in the speed sports and fast paced sports. Speed and fast limbs movements are the results of power and speed. As a result, the researcher notes the importance of testing the ability to jump before starting the training program and also during consequent periods in the season, and also during the transitional period which has a great effect on the level of achievement.

Due to the tremendous development of instrumentation through modern technology in the athletic field which helps in creativity in using new different methods in training to promote the performance level on which the skill achievement level depends. To save effort and time, it is important to make use of the modern technologies in training to recognize the level of the players in a specific important capability which is muscular power on which success in a lot of skills depend. It is also an important element in improving other skills in the age stage less than 14 years. The coaches start to measure the jump height in testing physical fitness to recognize the jump distance and also compare it with others in the same age stage as there are many criteria according to the different age stages for athletes in the same age or in the age stage less than 10 years.

One of the studies that pay attention to the element of the muscular power is the study of Mohamed Bellal (2003), the study of Goran Markovic (2007), the study of Osama El Nemer (2013), the study of EhabBedewy et al (2016), the study of Andrwe J et al (2017) and the study of Mohamed Farouk et al (2017). These studies pay attention to the importance of jump capability and its relationship with some skills or with the level of performing the capability itself and

promoting with its level through different training programs. To compare some of these studies use one of the technological equipment which is called OptoGait because of its accurate and fast results.

Because of the importance of the muscular power, both NBA and NFL ask players who want to share in the competition to undergo a number of tests, the most important of which is the vertical jump test.

So the thesis problem is presented in assessing the reference of the muscular power by using the infrared technology to recognize the level of the players in this age stage less than 14 years which is considered a primary stage that needs the data to be more accurate, and also we can compare each player with his mates or with the rates of the same stage in next levels.

## 2. Materials and Methods

### Research curriculum:

The researcher uses the descriptive curriculum with survey method because of its appropriateness for the research procedures.

### Research fields:

#### Human field

The research sample consists of 8 young players aged less than 14 years born in 2004.

Table (1) clarifies the statistical description of the research sample N= 8

Standard deviation	SMA	Measuring unit	Main variables
12.164	173.625	cm	length
12.498	61.25	kg	height
0.988	5.362	year	Age



Equipment's and tools used in the research:

OptoGait with 3 meters tall (3 barriers) to measure the variable of muscular power (the jump capability) depending on the infrared technology in measuring and analyzing the research variables which are:

Contact time.  
Flight time.

Elevation of center of gravity.

Used area.

Power.

Pace.

Jumping point.

Gap jumping point.

Two cameras mounted on a meter stand and the camera speed is 30 frames per second.

OptoGait program on a laptop.

Used tests:

Squat jump left leg 5 times.

Squat jump right leg 5 times.

Double legs squat jump.

Used tools:

Four measuring bands to measure height to the nearest cm value.

Calibrated medical balance to measure the weight to the nearest kg value.

Main experiment:

The research tests were applied by using the OptoGait equipment.

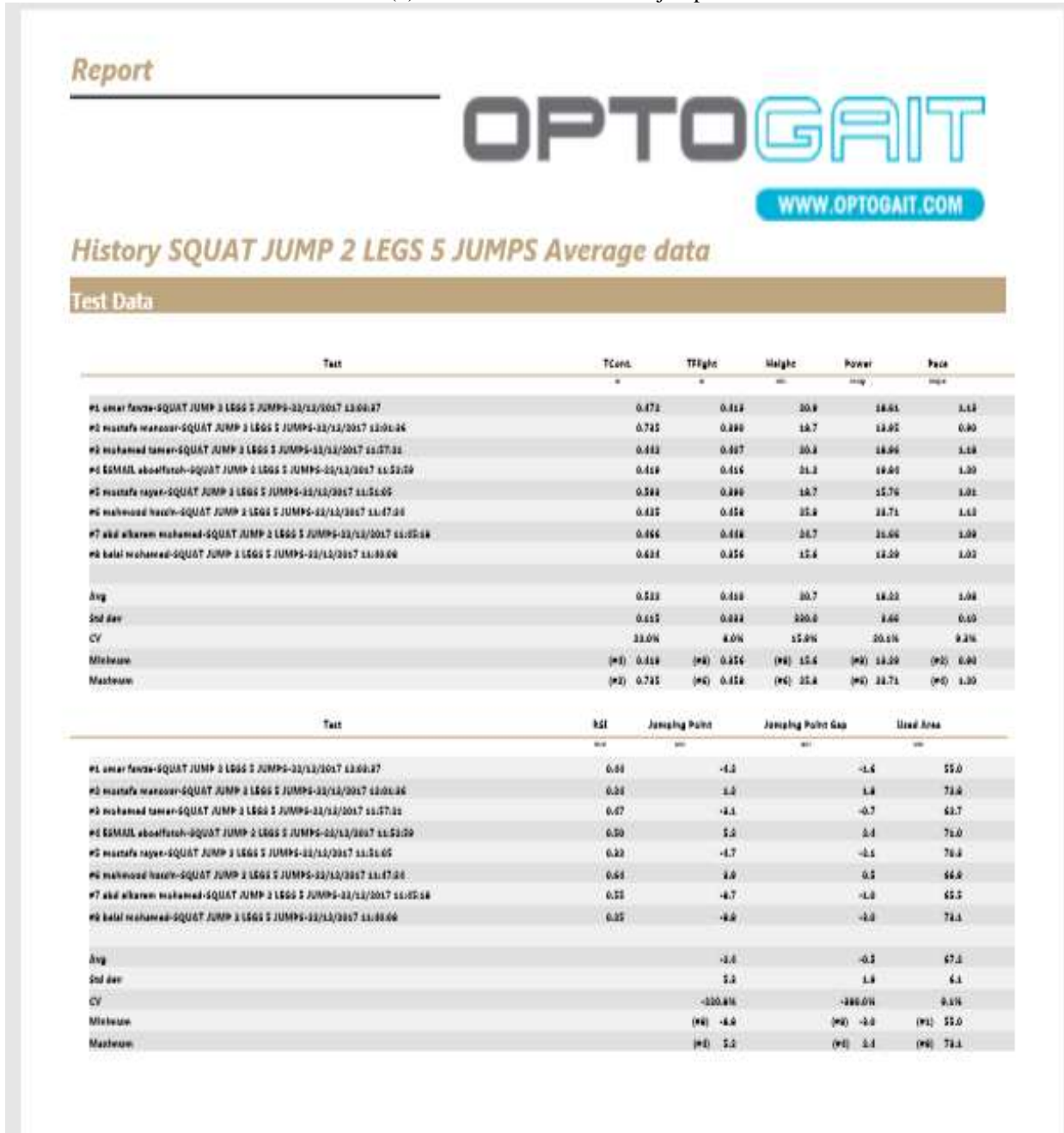
**3. Results**

Present the results that are found through the recorded data from the used equipment which are recorded automatically during performance and also

some statistical treatments in variables such as contact time, flight time, evaluation of center gravity and power.

First: results presentation:

Table (2) clarifies the results of the jump test

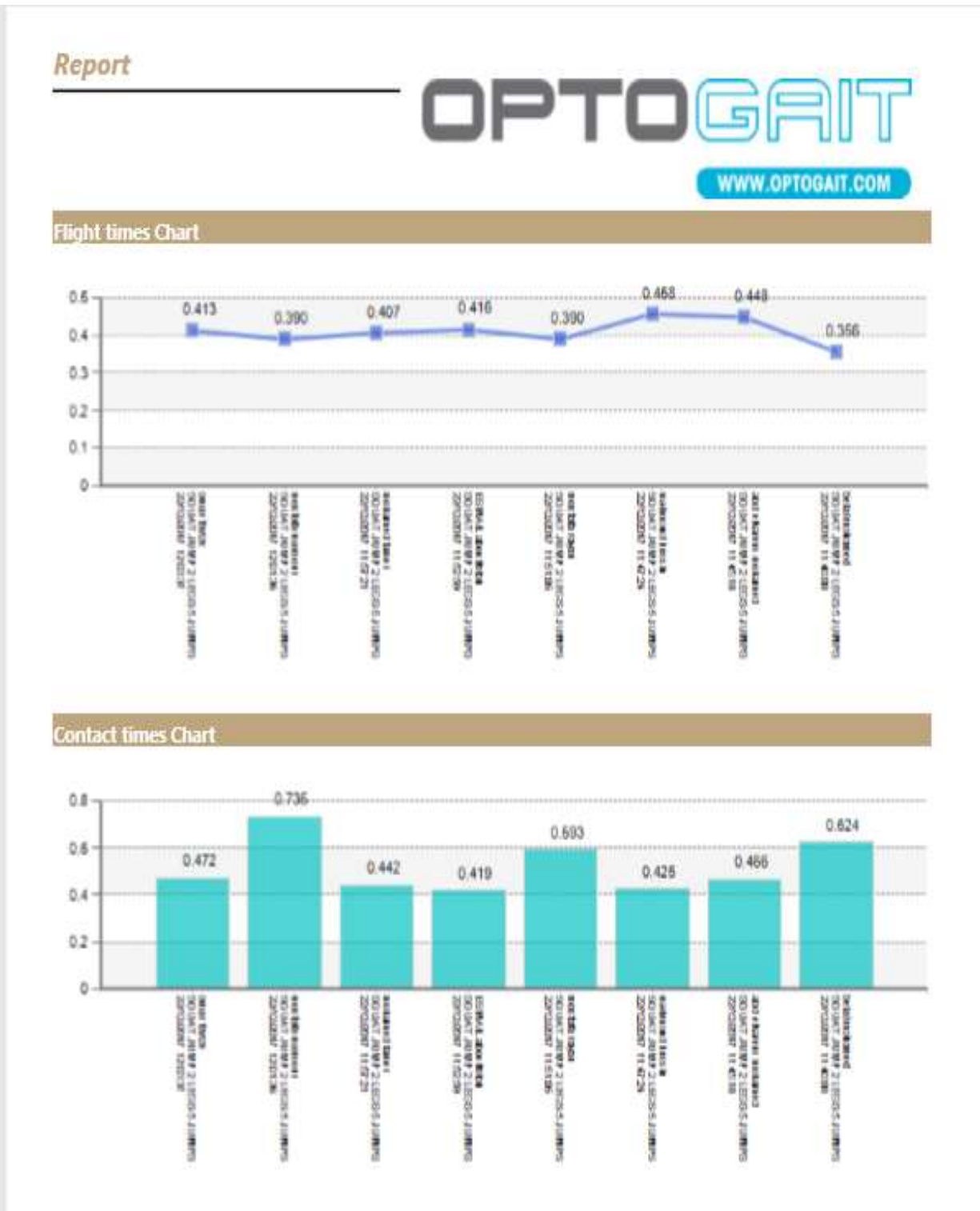


Test	TCont	TFlight	Height	Power	Pace
#1 Omar Farouk-SQUAT JUMP 2 LEGS 5 JUMPS-22/12/2017 13:00:27	0.472	0.414	20.8	18.61	1.12
#2 Mostafa Haneen-SQUAT JUMP 2 LEGS 5 JUMPS-22/12/2017 13:01:26	0.725	0.398	18.7	12.92	0.90
#3 Mohamed Tamer-SQUAT JUMP 2 LEGS 5 JUMPS-22/12/2017 11:57:01	0.433	0.407	20.3	18.96	1.18
#4 SEMAN aboufateh-SQUAT JUMP 2 LEGS 5 JUMPS-22/12/2017 11:52:29	0.429	0.424	21.1	19.40	1.20
#5 Mostafa Nageh-SQUAT JUMP 2 LEGS 5 JUMPS-22/12/2017 11:51:05	0.588	0.396	18.7	15.74	1.01
#6 Mahmoud Hady-SQUAT JUMP 2 LEGS 5 JUMPS-22/12/2017 11:47:00	0.425	0.424	22.8	21.71	1.13
#7 abd alkarim mohamed-SQUAT JUMP 2 LEGS 5 JUMPS-22/12/2017 11:35:58	0.464	0.418	21.7	19.66	1.09
#8 balal mohamed-SQUAT JUMP 2 LEGS 5 JUMPS-22/12/2017 11:30:06	0.621	0.356	15.4	12.29	1.02
Avg	0.523	0.418	20.7	18.22	1.08
Std dev	0.115	0.022	200.0	2.46	0.10
CV	22.0%	5.0%	15.0%	13.5%	9.2%
Minimum	(#8) 0.318	(#8) 0.356	(#8) 15.4	(#8) 12.29	(#2) 0.90
Maximum	(#2) 0.725	(#6) 0.424	(#6) 22.8	(#6) 21.71	(#4) 1.20

Test	hSI	Jumping Point	Jumping Point Gap	Used Area
#1 Omar Farouk-SQUAT JUMP 2 LEGS 5 JUMPS-22/12/2017 13:00:27	0.59	-4.2	-1.4	55.0
#2 Mostafa Haneen-SQUAT JUMP 2 LEGS 5 JUMPS-22/12/2017 13:01:26	0.58	2.0	1.8	73.8
#3 Mohamed Tamer-SQUAT JUMP 2 LEGS 5 JUMPS-22/12/2017 11:57:01	0.67	-4.1	-0.7	62.7
#4 SEMAN aboufateh-SQUAT JUMP 2 LEGS 5 JUMPS-22/12/2017 11:52:29	0.50	2.2	2.1	71.0
#5 Mostafa Nageh-SQUAT JUMP 2 LEGS 5 JUMPS-22/12/2017 11:51:05	0.32	-1.7	-1.1	79.8
#6 Mahmoud Hady-SQUAT JUMP 2 LEGS 5 JUMPS-22/12/2017 11:47:00	0.61	2.0	0.5	64.8
#7 abd alkarim mohamed-SQUAT JUMP 2 LEGS 5 JUMPS-22/12/2017 11:35:58	0.55	-4.7	-1.8	65.5
#8 balal mohamed-SQUAT JUMP 2 LEGS 5 JUMPS-22/12/2017 11:30:06	0.35	-8.8	-1.8	73.1
Avg		-2.0	-0.5	67.1
Std dev		2.8	1.8	4.1
CV		-220.0%	-280.0%	9.1%
Minimum		(#8) -8.8	(#8) -1.8	(#1) 55.0
Maximum		(#1) 2.2	(#1) 2.1	(#6) 73.1

The previous table presents the SMA and the standard deviation and the least and highest values of the variables in the ability to jump with both legs which is the contact and the flight time, the jump height, the muscular power and the used area.



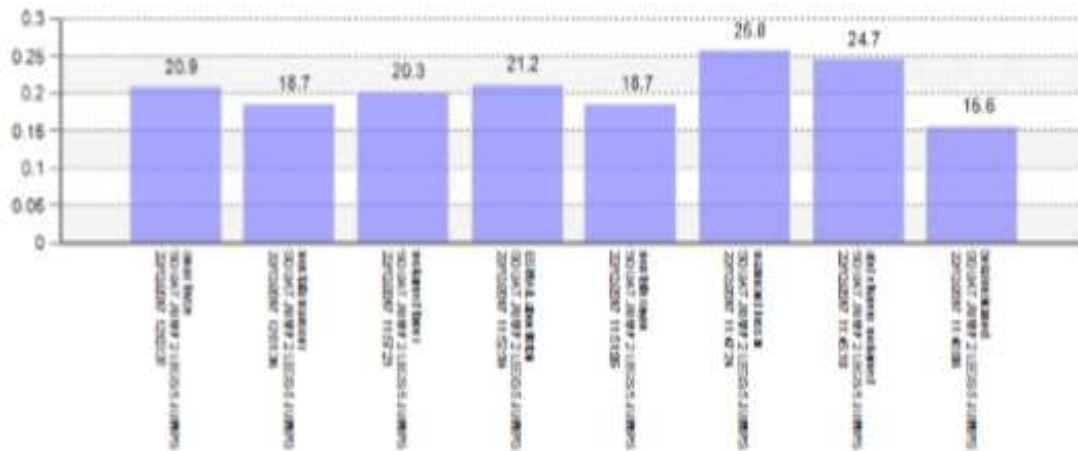
Shape (1) presents the variables of contact and flight times for basketball players

Report

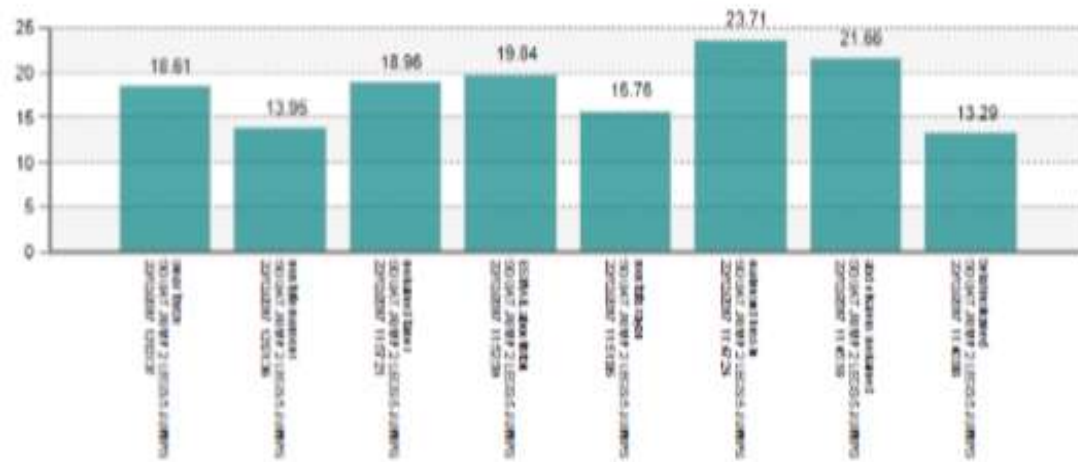
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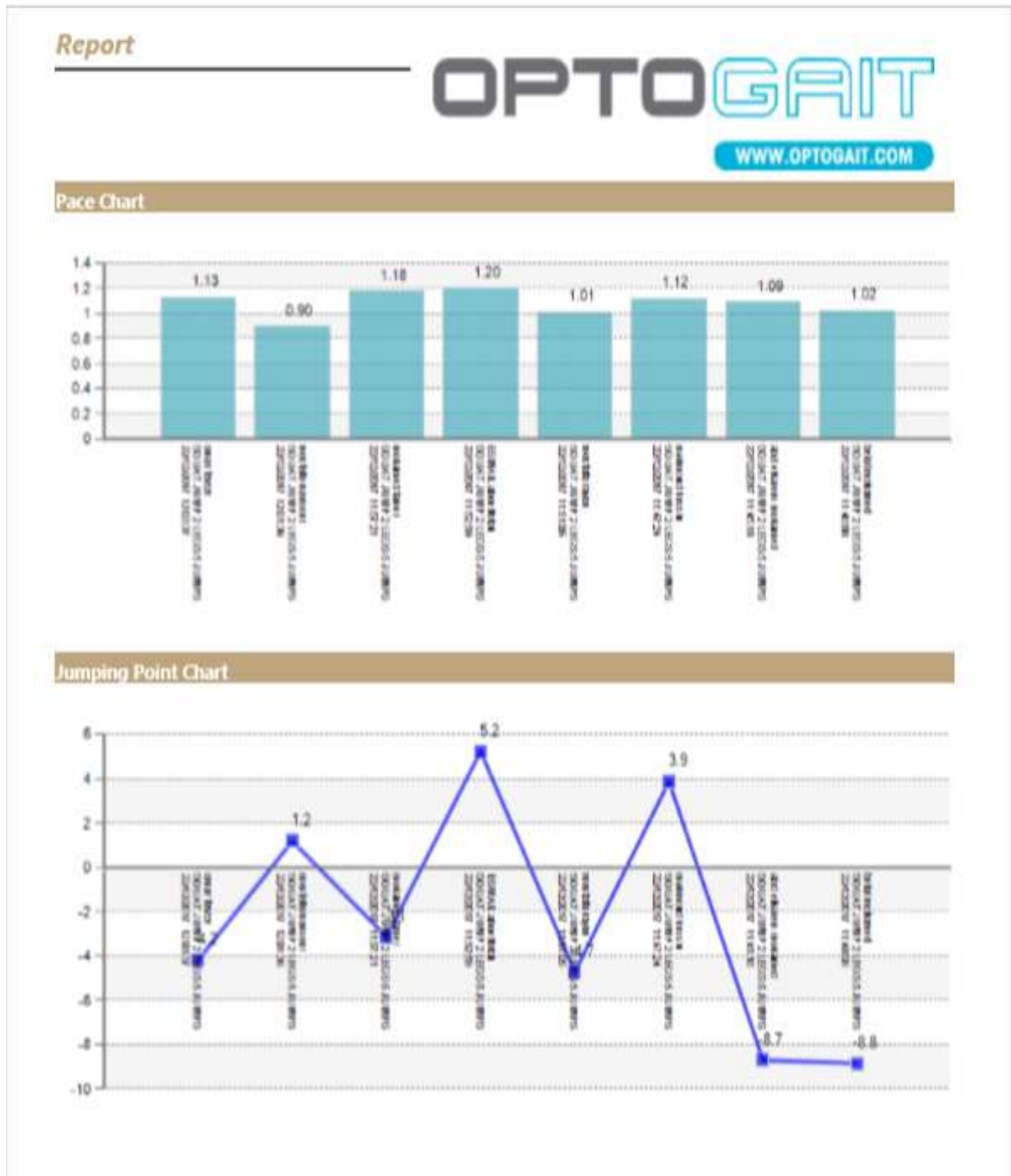
## Height Chart



## Power Chart



Shape (2) presents the jump height and power



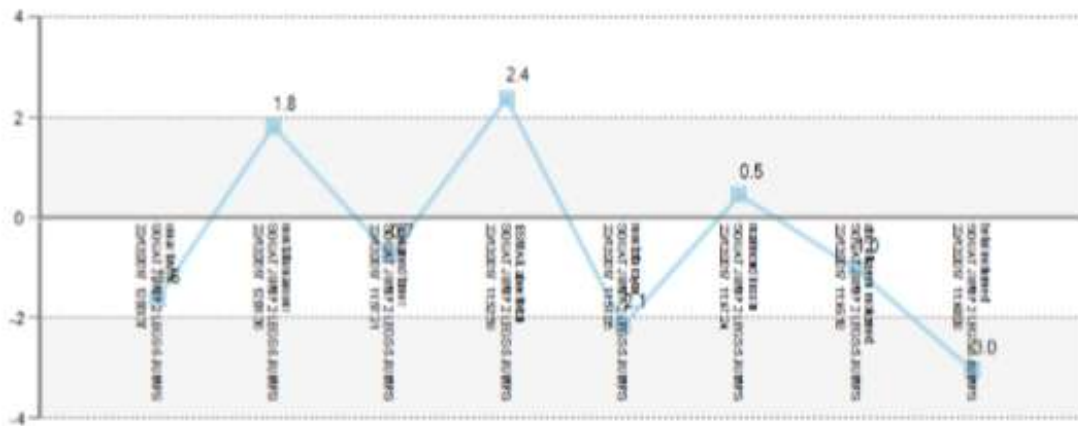
Shape (3) presents the area and the jump point

Report

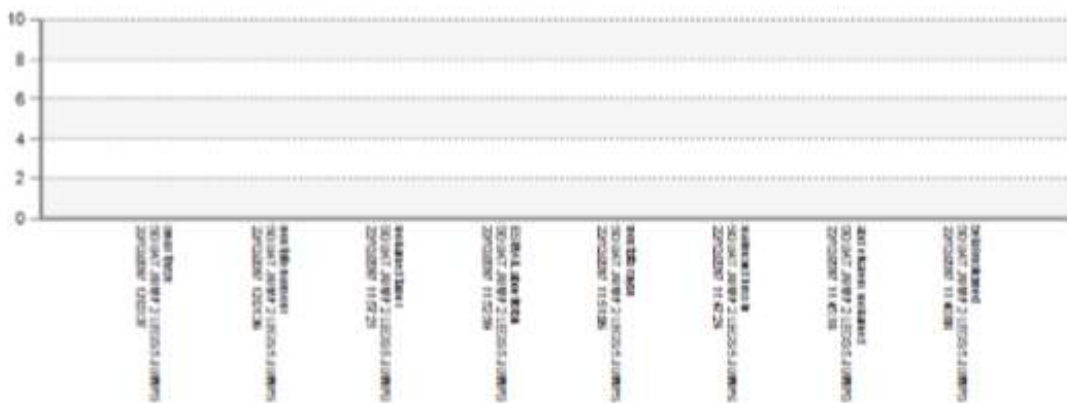
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### Jumping Point Gap Chart



### Used Area Chart



Shape (4) presents the area used in the jump

Table (3) presents the statistical average, the standard deviation, the least and highest average of the variables for the research sample in left leg, right leg and both legs jumping

Maximum	Minimum	CV	Standard deviation	Average	Testes	Variables
0.641	0.430	16.1%	0.088	0.547	right	T contact second
0.727	0.387	21.8%	0.118	0.541	Left	
0.735	0.419	22%	0.115	0.552	2 Legs	
0.314	0.208	12.9%	0.035	0.272	right	T flight second
0.337	0.200	17.9%	0.048	0.268	Left	
0.458	0.356	8%	0.033	0.410	2 Legs	
12.1	5.3	23.9%	220	9.2	right	Height cm
13.9	4.9	34.1%	310	9.1	Left	

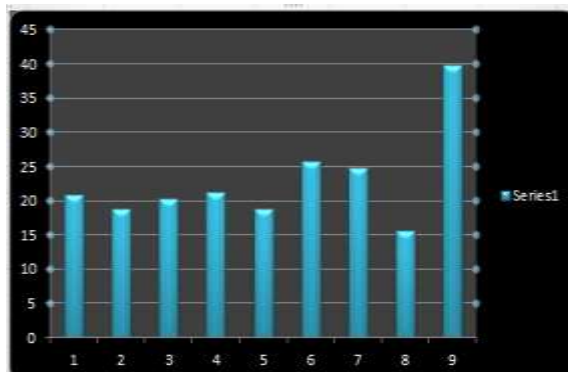


25.8	15.6	15.9%	330	20.7	2 Legs	Power Wat/kg
13.18	6.59	19.6%	1.92	9.82	right	
15.48	6.07	31.2%	3.18	10.20	Left	
23.71	13.29	20.1%	3.66	18.22	2 Legs	
1.35	1.08	9.7%	0.12	1.24	right	Pace second
1.41	1.08	10.4%	0.13	1.25	Left	
1.2	0.90	9.3%	0.10	1.08	2 Legs	
-7.9	-30.2	-48.4%	8.9	-18.4	right	J- Point second
23.2	-13.7	112.1%	12	10.7	Left	
5.2	-8.8	220.8%	5.3	-2.4	2 Legs	
-1.2	-9.7	-72.5%	3.7	-5.1	right	J-P-Gap second
5.8	-9.4	384.6%	5	1.3	Left	
2.4	-3	-380%	1.9	-0.5	2 Legs	
21.2	11.5	17.8%	2.8	15.7	right	Used Area meter
19.8	14.4	13.5%	2.2	16.3	Left	
73	55	9.1%	6.1	67.2	2 Legs	

Table (4): Average Vertical Jump: By Age, Sport, NBA and NFL (High School Athlete Jump Averages Chart)

Age	Vertical
10 years old	10.9 inches
11 years old	12.1 inches
12 years old	13.3 inches
13 years old	14.5 inches
14 years old	15.7 inches
15 years old	17 inches
16 years old	18.2 inches
17 years old	19.5 inches

The previous table presents the average of the age in secondary school between 14 and 18 years old and its level. The data also contains the younger students to recognize and compare their levels with the other young athletes and students in the same age stage.



Shape (5) presents the comparison between the players' level and the jump distance for athletes in the same age high level age

The previous table and shape present that there are obvious differences between the players' level and the levels achieved by the players in the same age as

the jump height is 15.7 inches (39.878 cm) and the highest average for jump for the players is 25.8 cm.

Jump with two legs is considered a test to measure the player exit energy directly by seeing the highest range to which the player can jump with one movement. It is also an important evaluation for the sports such as basketball, volleyball and even football. Starting a vertical jump test at an early age helps aspiring athletes track their progress. It is an objective way to control the specific trainings to know whether it is effective and achieved the goals, we can also make a test for jump ability before seasonal training, every month or two months per season, and also during the transitional period. Jump relative results percentage for males between 13 and 14 years is approximately 17 inches. The fitness expert Gay Hoffman mentioned in "the rules of fitness, performance and health" that the percentage 10 to 20 % is between 12.3 and 13.8 inches, the percentage 30 to 40% is between 15 and 16 inches. The highest average for the vertical jump is the percentage 60 to 70% that is between 18 and 19 inches. Excellent rank is 80 to 90 % which is between 20 and 21 inches. The professionals jump over 27 – 30 inches (28.58 – 76.2 cm), the coaches should attempt to

achieve this level and percentage by using the training programs for players aged 14 years old.

Comparing the results of individuals with the results of hump height and the ability to jump, it is clear that players number 6 and 7 are 178 and 183 cm height and that the average of jumping is 25.8 and 24.7 cm and the ability is 23.7 and 21.66 WK. out of these results, it is clear that measuring height has an effect on the results of the players because it offers a good chance for the player who has the ability to jump. As a result of the required muscular power, some players cannot use that power in spite of their tall. In this results both EsamAbd El Khalik (2005) and Emad El din Abbas (2007) agree that the anthropometric measurements are of the individual characteristics that is related with achieving high levels as it is used in selecting because of its great significance in predicting the results that the player can achieve. The most important measurements are heights, width, and the relation between them, the weight, body metrics, limbs and the mutual relationship between these measurements. Excel in game performance requirements is not related with the interest in anthropometric measurements individually but there is an important element which is the relation that link all these measurements with each other such as the relation between height and weight or between the length of a specific limb and the overall height, this relation is represented with the proportion of body parts or fit parts.

Mohamed Allaouy and Nasr El din Radwan (2001) emphasized that there is a relation between the physical form or shape of the person (height – weight – the surroundings) and the possibility to achieve high levels and that each sport activity has a specific physical features that we should pay attention for them in choosing the suitable person.

## 5. Conclusions

The average of the players' level in the height of the center gravity from the ground" the jump height" is 25.8 cm which is less than required as the high level of the same age is 39.87 cm (15.7 inches).

## Recommendations:

1. Using the modern technological equipments in measuring such as the OptoGait because of its accuracy, speed and objectivity in finding results.
2. Paying attention to the programs of improving and developing the muscular power through the bolometric exercises and the lengthening and default course to apply the principle of specialization in training.

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Conflicts of Interest:

“The authors declare no conflict of interest.”

## Appendix A

Used tests

First test:

Squat jump two legs five jumps.

Test purpose: evaluating the muscular ability for the lower limb.

The way to perform:

The player stands between the two barriers.

The player starts the performance from the standing point, putting his hands in his waist and stands vertically.

The player jumps five times consequently with his two legs when he hears the start whistle from the equipment and from the person who is responsible for measuring.

The measured variables: contact time – flight time - elevation of center of gravity – legs fort together.

Result calculating: the equipment gives results directly after each jump of the five then the statistical average, the standard deviation and the least and highest values.

The second and the third tests:

Squat jump with right – left legs (5 jumps) test

Test purpose: evaluating the muscular ability for the lower limb, (each leg).

The way to perform:

The player stands between the two barriers.

The player starts the test from standpoint on the right leg and lift the left leg and then bend the knee, and vice versa.



The player jumps five times consequently with the right / left leg when he hears the start sound of the

equipment and the whistle of the person who is responsible for measuring.

#### Result calculating:

The test measures the following variables:

Contact time – flight time - elevation of center of gravity – right / left leg fort.

The equipment gives results directly after each jump of the five then the statistical average, the standard deviation and the least and highest values for each leg (right / left).

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