Ilkogretim Online - Elementary Education Online, 2024; Vol 23 (Issue 4): pp. 159-172
http://ilkogretim-online.org
doi: 10.17051/ilkonline.2024.04.13

The Relationship Of Some Physical Abilities And Their Contribution To The Performance Of Spike Serve Skill In Volleyball, Field Study On The Youth Of The National Team (16-17 Years)

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Received: 10/2024, Published: 11/2024

Abstract:

The study aims to identify the type of relationship between certain physical abilities and the skill of Spike Serve and the extent to which these physical abilities contributes to it.The study uses the descriptive correlation method. The sample included six (06) players from the Algeria national youth volley-ball team (16-17 years). The following physical tests have been used (throwing the medicine ball (2kg) from above the head, Sargent test, five jump test, Nilson test adjusted, the movement frequency test, and raising the arms with the stick). The spiking performance was also filmed and analyzed by software (kinovea).

After the use of statistical methods appropriate to the study, the following conclusions have been reached: a significant correlation exist between some physical abilities (explosive legs strength, force-velocity) and performance of the skill of Spike Serve. There is a variation in the percentage of contribution of physical abilities to the skill of Spike Serve.

Keywords: physical abilities; the Spike Serve; youth (16-17);volley-ball.

1. Introduction:

Sports training has been mainly based on practical experience and traditional practice with modest and simple tools and techniques. With the great prosperity witnessed by the field of sports training thanks to scientific and technological progress, understanding the requirements of sports activity and the needs of athletes has become deeper, through the development of accurate measurement and evaluation techniques, kinetic analysis, biosensing, and others.

When talking about volleyball, we cannot ignore the development it has achieved in the field of functional, physical and tactical preparation, which was not a coincidence but rather the result of great research and efforts, in addition to benefiting from field applications to raise the level of tactical and skillful performance with a scientific training methodology that would bring the player to the highest skill level (Al-Dulaimi et al., 2015, pp. 11-12), in addition to using accurate analysis of players' skills through the use of motion photography and kinetic and biosensing, which allows the extraction of their physical, bodily and motor requirements. When mentioning skills, we focus in particular on the skill of the smash.

The smash is considered a direct offensive serve, as it has become the most influential and dangerous in the opponent's court (Al-Biruni & Qablan, 2012, p. 120), as its speed has so far reached (2023) (134 km/h) by the Polish player Wilfredo Leon (volleyballpassion, 2023). It is also the most difficult for defenders because the ball's flight time is relatively short because it travels at a higher speed and has an upper spin (topspin), which leads to a rapid drop of the ball, resulting in scoring a direct point (ace) or a difficult reception (Bhasi & Sadanandan, 2022, p. 267). The use of the jump serve, especially the smash, has developed remarkably, as from the nineties until today the use of the jump serve in high-level tournaments has increased from (20.8%) in (1992) to (99.2%) in (2002) (Lopez, 2013, p. 37). It occupies the first place in modern high-level volleyball, and a team is not considered prestigious and prestigious unless it includes at least three players who master its performance (Paolini, 2002, p. 21). For example, during the (2008-2009) season of the Italian men's premier league (top league), the smash serve was the most used at a rate of (69.9%), followed by the wavy jump serve (26.9%) and then the wavy serve (3.3%) (Ciuffarella, et al., 2013, p. 29). It is worth noting that the implementation of this type of serve The player is required to have high physical and bodily specifications and high technical control to be able to perform correctly, quickly and strongly coupled with accuracy and direct impact (Al-Kateb and Al-Saadi, 2002, p. 52) (Corroyer, 2013, p. 18). Given the importance of the skill, there is no doubt that it requires the availability of certain physical qualities that would contribute to its optimal performance during competitions to achieve the desired goal. Hence, researchers seek to identify some of these physical qualities and try to know the extent of their contribution to the performance of the smashing serve skill in detail among the national team cubs aged (16-17 years) as well as to know the capabilities that contribute most to this skill. Hence, the research problem is summarized in the following

questions: What is the nature of the relationship between some physical qualities and the smashing serve skill in volleyball? What is the extent of their contribution to this skill? What is their ranking according to importance?

Research Objectives: This research aims to:

1. Identify the nature of the relationship between some physical qualities and the skill of the smash.

2. Identify the percentage of contribution of some physical qualities to the skill of the smash.

3. Identify the order of physical qualities contributing to the skill of the smash.

Research Hypotheses: The researchers assume that:

1. There is a significant correlation between some physical qualities and the performance of the smash.

2. There is a variation in the percentage of contribution of some physical qualities to the performance of the smash.

Research Terms

Physical qualities: Abdulkhaleq defines it as "a multi-faceted concept related to health, structural, functional and psychological aspects" (Abdulkhaleq, 2003, p. 85), and Salama defines it as a set of functional abilities required to perform specific tasks that require muscular effort while paying attention to the individual performing the work and the work performed in terms of quantity and quality (Salama, 2000, p. 22).

The smash: The smash is generally known as the strike that starts the game and is resumed after each error and the end of each half. The smash is executed by the player in the right back position of the team, using his open or closed hand or any part of his arm to hit the ball towards the opposing team's court to start the game. The main goal of the smash is to put the ball in play and control the ball in the game (Al-Dulaimi et al., 2015, p. 58). The smash requires the player to have high physical, skill and body specifications to be able to perform correctly, quickly and strongly, coupled with accuracy and direct impact (Al-Kateb and Al-Saadi, 2002, p. 52).

Volleyball cubs: They are the players practicing volleyball and registered with the Algerian Volleyball Federation, whose ages range between 16-17 years (Algerian Volleyball Federation) (FAVB).

2. Research procedures

Research methodology: The researcher used the "descriptive correlational" method for its suitability and the nature of the research.

Research sample: The research sample included six (06) players from the Algerian national volleyball team (16-17 years old), and they were chosen intentionally according to specific criteria, such that each of them was excluded (the free player, the injured player, the player who was not serious in the tests).

Table No. 1 shows the characteristics of the research sample.

	Age (years)	Height (cm)	Body mass (kg)

Arithmetic mean	17.5	189	73.08
Standard deviation	0.54	2.65	5.22

Research tests:

A set of tests were applied to the research sample after reviewing many specialized references and previous and similar studies. They are as follows:

1- Test of throwing a medicine ball weighing (2) kg from a sitting position on a chair:

Purpose of the test: Measure the explosive power of the arm muscles.

Tools used: Chair, medicine ball weighing (2) kg, belt to fix the tester on the chair, measuring tape.

Description of performance: The tester sits on the chair and is fixed by a belt from the middle of the body to prevent the movement of the trunk and back and their participation in the performance, and from the sitting position the player performs three attempts to throw the ball to the farthest distance.

Recording: The best attempts are counted and the measurement is in meters and their parts (Alawi and Radwan, Motor Performance Tests, 1994, page 110).

2/ Vertical jump test from a standing position (Sargent test):

Purpose of the test: Measure the explosive power of the leg muscles

Tools used: Camera, smooth wall, measuring tape, video analysis program.

Description of performance: The camera is placed 5 meters away at a height of 1.20 meters and the player stands next to the wall, extending the arm as high as possible (point A), then the tester swings the arms down and back while bending the torso forward and down and bending the knees halfway (right angle), extending the knees and pushing the feet together to jump upwards and swinging the arms forcefully forward and upwards to reach the maximum possible height (point B).

Recording: The jump distance between (A) and (B) is recorded. (Ratel & Martin, 2014, p. 158)

Note: The camera and video analysis program were used to ensure accuracy and save time and effort.

3/Jump Test:

Purpose of the test: To measure the specific strength (characterized by speed) of the leg muscles.

Tools used: Measuring tape, ascent line.

Description of performance: The player stands behind the starting line, with one foot in front and the other behind, then he begins to jump forward, pushing on the supporting leg and landing on the leg swinging forward, i.e. from the right leg to the left, and alternating with repeating these jumps until the fifth jump.

The feet are raised together, then one of the feet is landed on, and so on... etc.

Recording: The distance is measured from the inner edge of the ascent line to the last point close to the ascent line

Note: The starting line is (5) cm wide and is included in the measurement (Jasanin, 1987, page 265)

4/Motor frequency speed test:

Purpose of the test: Measure the motor speed of the arm (motor frequency).

Tools used: Table, 2 sticky paper discs, camera.

Description of the performance: After sticking the two paper discs (20 cm in diameter) to the table, forming a horizontal search distance of (60 cm) from each other, the tester stands in front of the table, placing his left hand (if right-handed) and his right hand (if left-handed) between the two discs, and when indicated, he touches the discs with the other hand 25 times back and forth.

Recording: The performance time is calculated (Cayla & Lacrampe, 2007, p. 110).

Note: For more accurate results, the researchers used a camera and a motor analysis program.

5/ Nelson's Transitional Motor Response Test (modified):

Purpose of the test: To measure the ability to respond and move quickly and accurately according to the choice of stimulus. This test was developed on the basis that it resembles the motor patterns in a number of sports.

Tools used: A flat area free of obstacles, 10 m long and 2 m wide, a stopwatch, a measuring tape, a camera.

Procedures: The test area is marked with three lines, each line is 3.2 m apart and the line is 1 m long.

Performance Description: The tester stands at one end of the center line facing the judge who stands at the other end of the line. The tester assumes a ready position with the center line between the feet, bending his body slightly forward. The judge holds the stopwatch in one hand and raises it up, then quickly moves his arm either to the right or to the left with an audible alert (for the camera). The tester responds to the hand signal and tries to run as fast as possible in the specified direction to reach the side line, which is 3.2 m away from the center line. If the tester appears to be in the wrong direction, the judge continues to calculate the time until the tester changes direction and reaches the correct side line.

The tester is given ten consecutive attempts, with 20 seconds between each attempt, at a rate of five attempts on each side. The attempts on each side are chosen randomly (Al-Diwan, 2015).

6-Shoulder Lifting Test with a Stick:

Purpose of the test: To measure the ability to lift the shoulders up from a prone position (shoulder flexibility).

Needed tools: Ruler, stick.

Description of performance: The tester assumes a prone position on the stomach, extending the arms shoulder-width apart, and the tester grasps the stick and raises it and raises it up as high as possible while keeping the chin touching the ground and the elbows and wrists extended.

Recording: The distance is measured from the ground to directly below the stick (Alawi and Radwan, 1994, p. 341).

7- The crushing serve test: To ensure scientific observation, the researcher used the camera (Canon XA10) which was placed at a distance of about (7) meters, on the right side of the field and was at a height of (1.5) meters above the level of the field floor. The players were also given black suits that were close to the body with light-colored reflective adhesive tapes attached to the joints in addition to one on the head with a white background provided so that the video would be clearer. An observation and evaluation card was built for the crushing serve skill by the researcher based on the analysis of similar sources and studies, in order to choose some biokinetic and technical variables, then presented to some experts with field experience and scientific competencies to verify the validity of the standards relied upon in the evaluation process, as well as with regard to the evaluation network. The skill was divided into four technical stages, and the kinetic analysis program "kinovea" was used to analyze the skill kinematically (distance, time, angle value..), and with reference to references and studies Similarity: The researcher used the analysis of the skill performance of many professional players, and designed a scale for evaluation at four levels (A=4, B=3, C=2, D=1) so that the full mark is (60), and regarding the quantitative values, the researcher limited them to magazines (categories) and each category has a mark.

Exploratory experiment: The exploratory study is based on the method of applying the test and reapplying it, where the tests were conducted on (7) players from the cubs (16-17 years old) of the (SAS) team in Ain Smara (Constantine), then the same tests were repeated after a week.

Main study: After verifying the quality criteria of the physical tests and the crushing skill evaluation form, the main experiment was applied to the basic research sample on (March 25, 2017) during the closed training camp held at the National School of Olympic Sports - El Baz - in the state of Setif.

Statistical methods: The data were statistically processed using the following methods (arithmetic mean, standard deviation, Pearson's simple correlation coefficient, adjusted coefficient of determination).

Displaying the results of the relationship between physical qualities and the smashing skill of the national team players:

In order to know the nature of the relationship between physical qualities and the smashing skill of the national team players, the data was processed and descriptive statistics were conducted for the variables, then Pearson's simple correlation coefficient was used and the results were as in Table No. (02) below:

Table (02) shows the inter-correlation coefficients between some physical qualities and the smashing skill of the national team players.

	correlation	Strength Explosiveness of arms	Strength Explosiveness of legs	Strength power	Speed Frequency Motor	Speed Response Motor	Flexibility of shoulders
the crushing serve	Pearson's correlation coefficient	0.443	***0.886**	***0.878**	-0.498	-0.553	-0.437
	Test probability	0.379	**0.019**	**0.022**	0.314	0.255	0.386
	Sample number	06	06	06	06	06	06

***Significant at an error rate <5% **Significant at an error rate <1%**

From Table (02) for the inter-correlation coefficients of some physical characteristics of the performance of the smash skill among the national team players:

The probability value of the Pearson simple correlation coefficient test, which is (0.019), for the variables explosive power of the legs and the performance of the smash skill is less than the error rate (5%), which indicates the existence of a significant correlation between the variables, and the value of the correlation coefficient, which is (0.886), indicates the existence of a direct and strong correlation between them.

It is also clear that the probability value of the Pearson simple correlation coefficient test, which is (0.022), for the variables characterized by speed and the performance of the smash skill is less than the error rate (5%), which indicates the existence of a significant correlation between the variables, and the value of the correlation coefficient, which is (0.878), indicates the existence of a direct and strong correlation between them.

As for The remaining variables (explosive strength of the arms, speed of motor frequency, speed of motor response, flexibility of the shoulders) do not have a significant correlation between them and the performance of the smashing skill because the probability of their tests (0.379) (0.314) (0.255) (0.386) is greater than the error rate (5%).

Displaying the results of the percentage of the influence of physical characteristics on the smashing skill among the national team players:

In order to determine the percentage of the influence of physical characteristics on the smashing skill among the national team players, the data were statistically processed using the modified coefficient of determination to show the results as in the following Table No. (03):

Table (03) shows the percentage of the influence of some physical characteristics on the performance of the smashing skill among the national team players.

	correlation	**Strength Explosiveness of arms**	**Strength Explosiveness of legs**	**Strength power**	**Speed Frequency Motor**	**Speed Response Motor**	**Flexibility of shoulders**
the crushing serve	Effect ratio	%0.5	**%73**	**%71.3**	%6	% 13.2	% 1.1
	Effect ratio probability	0.379	***0.019**	***0.022**	0.314	0.255	0.386
	Significant effect order	**-**	**1**	**2**	**-**	**-**	**-**

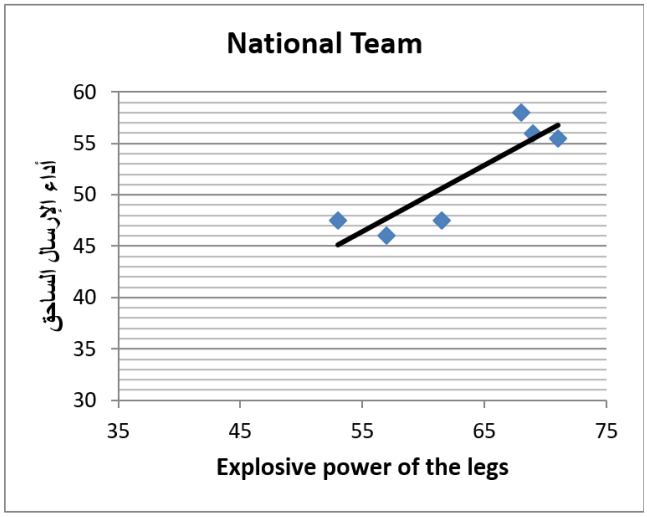
*** Significant at an error rate <5% (** Significant at an error rate <1%**

From Table (03) for the percentage of influence of some physical characteristics on the performance of the smashing skill, it is clear that:

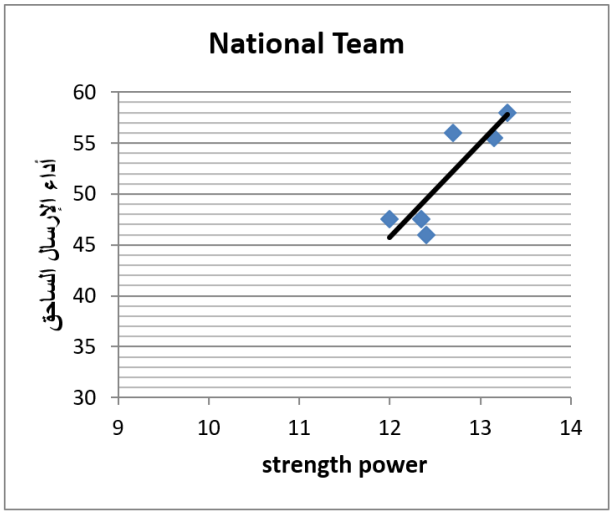
The highest percentage of moral influence on the smashing serve was for the explosive strength characteristic of the legs at a rate of (73%), so that the probability of the adjusted determination coefficient was (0.019) which is less than (5%), followed by the strength characterized by speed at a rate of (71.3%) so that the probability of the adjusted determination coefficient was (0.022) which is less than (5%).

As for the rest of the characteristics, their effect was not significant because the values of the probability of their adjusted determination coefficient were greater than (5%).

3. **Discussion of the results of the relationship and percentage of influence of physical characteristics on the smashing serve of the national team players:**



Graph (01) shows the simple linear regression between the two variables: explosive power of the legs and the performance of the smashing skill among the national team players.



Graph (02) shows the simple linear regression between the two variables: speed-specific strength and smash skill performance among the national team players.

Through the results shown in the tables of correlations and percentage of influence (02)(03), it is clear that there is a significant correlation between each of the explosive strength characteristic of the legs and the characteristic of the strength characterized by speed with the performance of the smashing serve skill of the national team, as well as its significant influence on the skill.

As is known, the smashing serve begins by throwing the ball up and forward from a relatively far distance from the line (about 5 meters) according to the player's height, and the launch is from a stationary position, which requires a pushing force from the legs. According to Newton's law, every body continues in its state of rest or regular movement unless a force affects it (Talha et al., 1998, p. 199). This force, according to Newton, is a measure of the internal reaction, which in humans is the reaction of the neuromuscular system (Al-Fadhli, 2010, p. 119). Al-Fadhli (2010) believes that the work is explosive at the moment of the push, and he considers that increasing the efficiency of the muscles means enhancing the overcoming of inertia for all skills that require sudden movement (pp. 95-110). This is for the purpose of providing kinetic energy for the launch so that running is done by pushing the body with explosive contractions in the muscles of the lower extremities (Ahmed et al., 2018, p. 154), which occurs during the approach steps that seek to obtain the greatest possible kinetic momentum (Omar and Shabib, 2007) This is by trying to gain horizontal speed, which means the availability of greater kinetic energy, especially since the approach distance in the smash serve is significant compared to other serves or smashes. The distinguished player is the one who exploits this distance to gain the greatest possible momentum, which requires the availability of the element of strength distinguished by speed, since this approach is done with quick steps (numerous explosive muscle contractions). This is based on what Al-Fadhli (2010) indicated, that theoretically it can be judged that the amount of movement the body possesses at a certain speed is directly proportional to the force produced (p. 87), and because the increase in the body's speed is

directly proportional to the force causing it, the approach must be executed at the greatest speed so that the player can ultimately execute a successful ascent (Al-Fadhli et al., 2016, p. 1746) because executing it well increases the height of the ascent by (12-20 cm) (Omar and Shabib, 2007). After the approach phase, which ends with providing the mechanical conditions for ascension by lowering the center of gravity of the body during the long step to facilitate the braking process in the last step, this is the station for adding the vertical path of kinetic energy (momentum) after it was only in a horizontal path, which requires, according to the researcher, muscular strength (explosive) at the level of the lower limbs, especially to control the resulting momentum and absorb that kinetic energy to become momentarily latent, as described by Omar and Shabib (2007), to then be transformed into greater kinetic energy in a vertical direction and in the shortest possible time to preserve the acquired energy (speed). The shorter the time the foot is in contact with the ground, the greater the distance the jumper obtains (Maqshoush et al., 2018). Al-Fadhli (2010) also indicated that the rebound force indicates that the player loses less speed during the ascension process (p. 99). It is worth noting here that the angle of ascension in the smashing serve is less than its counterpart in the front smashing strike due to the absence of the barrier (net), which allows for greater preservation of kinetic energy and reduction of the pivot time. On the ground, what makes the ascent further, which is what Maqshoush (2018) reported from the study (Fukushiro 1994) that the smaller the ascent angle, the greater the maintenance of horizontal speed, which means greater displacement, especially in its horizontal part (p. 349), and the presence of stops or angles makes the athlete lose strength, which forces him to create additional force (Kamash and Al-Shawish, 2011, p. 303), and this confirms, according to the researcher, the importance of explosive force in maintaining the acquired momentum and enhancing it to achieve ascent, as it is, according to Qais and Bastosi, one of the requirements for skill performance at the moment of ascent of the jumpers (Akkab, 2011, p. 194), as good ascent provides the scope for performing the skill in a smooth and good manner, as Al-Fadhli (2010) considers that pushing the force provides a jump with a great height, thus providing the appropriate conditions for performing some skills, such as the crushing serve (p. 99), in other words, it allows the exploitation of the principle of kinetic transfer smoothly away from sharp breaks in the kinetic chain (providing a larger scope) through Exploiting the kinetic momentum generated in a series starting from the lower limbs to be transferred to the trunk during ascent (by extending the trunk backwards) and then from the trunk to (by bending it forward) the shoulder, then the elbow, then the wrist, then the palm to hit the ball forcefully (Faraj, 2011, p. 51). This is based on what kinesiology states that the flow of force is transferred from one joint to another and from one muscle to another (Al-Fadli, 2010, p. 35), meaning that there is kinetic synergy between the body parts and a sequence in involving the largest possible number of muscles so that each muscle group supports another muscle group (Ibrahim and Mahmoud, 2014, p. 279). Thus, hitting is not dependent on the strength and muscles of the arm only, so that the hit ball is moved quickly as much as possible thanks to the effective kinetic chain during ascent (Baena-Raya & all, 2021, p. 02) Also, good ascent enables the ball to be directed at a sharper angle so that the player hits the ball from the maximum ascent point from the upper half of the ball (by surrounding the fingers), which reduces the distance the ball travels, i.e. increases its speed as well (Corroyer, 2013, p. 30) (Al-Shabib, 2012, pp. 14-15).

In addition, a balanced landing and the absorption of this great momentum requires a significant eccentric muscle contraction at the level of the lower limbs in particular, i.e. muscle strength (characterized by speed, as the landing phase is the last station for muscle contractions (or motor system) and this supports the opinion of Marwa (2015) who linked balance to the extent of development of muscle mass and strength (p. 129).

Through the aforementioned details, the great importance of strength, both explosive and speed-characterized, in performing the smashing skill becomes clear, especially since its main goal is to rise to the highest height to hit the ball forcefully (Lima, José, & Filipe, 2019, p. 266), which was confirmed by Al-Dulaimi et al. (2015) that explosive strength is one of the most important things a volleyball player needs, which enables the player to perform skills in a perfect manner, such as the smashing serve, as it requires a vertical jump to reach the highest point in preparation for its performance, and this depends on the explosive ability of the legs (p. 27), and the maximum speed of the serve ball is associated with the greatest amount of force generated by the lower and upper limbs (Baena-Raya, et al., 2021, p. 2), and therefore it is considered the decisive factor in the serve (smash) from above, especially the Ace, which requires explosive power for the legs and arms (Al-Biruni and Qablan, 2012, p. 17).

Alawi and Radwan (1994) also believe that explosive power is one of the most important components that are positively related to skill performance in many sports activities such as volleyball, as it allows him to perform high jump skills, including the serve (p. 78), and Hassanein and Abdel Moneim stipulated the availability of explosive power and the power characterized by speed, otherwise the serve will not be executed (Sakhi, 2014, p. 151), and Al-Dulaimi et al. (2015) also stipulated the availability of the power characterized by speed for the player performing the smash serve in order for it to be at a high level (p. 26). All this is consistent with the rule that states that the physical aspect forms a hall for the skill aspect, as Al-Kaabi (2019) quotes (Singer, N, Robert 1990) as saying: "The motor skill is not achieved without the presence of special physical abilities that enable the athlete to perform the motor performance of the skill in the best possible way" (p. 849). The difference in the order of the strength of the connections and the impact between the players of the national team and the players of some amateur clubs is attributed to the weakness of the elements of the latter (clubs) in terms of the explosive strength of the legs, which affected their overall performance and did not have the strongest connection, unlike the players of the national team. Therefore, we find Al-Dulaimi and others (2015) pointing to the importance of explosive strength as it mainly intervenes in the skill of the smashing serve, and confirming that explosive strength is one of the most important physical requirements in volleyball and that this characteristic occupies the first place among the order of physical characteristics in most sports (p. 27). We find that in the smashing serve it is the most exploited after the smashing strike compared to the rest of the skills by referring to the maximum jumping ability of the legs recorded in the laboratory, which was at a rate of (89%) (Wnorowski & all, 2013, p. 205).

4. Conclusion:

In light of the results presented, we conclude by emphasizing the importance of physical abilities in the skill performance of the smash serve and the extent of their significant

contribution to it, represented by explosive power and distinctive power with speed due to their close association with mastering this skill among cubs (16-17 years), as well as the necessity of working on developing them in scientific ways, and we specifically mention the explosive power of the legs as it has the strongest association and the highest contribution rate among the members of the national team as they represent the elite, which confirms its great importance in volleyball in general and in the skill of the smash serve in particular, and it is also worth noting the importance of exploiting technology (cameras and analysis software, etc.) for accurate observation and more objective evaluation, especially in complex and complicated skills such as the smash serve.

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