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Factorial study to identify the most important anthropometric measurements for selecting young volleyball players aged 9 to 12 years -The study was conducted in certain clubs in the provinces of Constantine and Mila in Algeria-

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Abstract:
This study aimed to determine the most important anthropometric measurements for selecting junior volleyball players, as the researchers used the descriptive approach with the survey method, and the study was conducted on volleyball juniors aged (9-12) years in the states of Constantine and Mila with a total of 43 juniors, anthropometric measurements were applied, which are: 05 measurements of lengths, which are: total body length, trunk length from sitting, arm length, leg length, palm length and 06 measurements of circumferences, which are: normal chest circumference, waist circumference, contracted humerus circumference, forearm circumference, thigh circumference, leg circumference and 04 measurements of symptoms, which are: shoulder width, chest width, hip width, knee width, in addition to body weight.
Among the most important conclusions reached in the study:
The following measurements were nominated and accepted:
- Lengths: leg length, total body length, arm length.
- Circumferences: humerus circumference, waist circumference, thigh circumference.
Keywords: Factorial study, measurements Anthropometry, Volleyball, Juniors (09-12 years).

1. Introduction:

Volleyball is one of the most popular team sports in the world. It has witnessed great development in recent years, thanks to the increasing interest in physical, technical and tactical preparation, as well as the adoption of modern and advanced training methods based on scientific foundations, which made it very popular all over the world, and is considered one of the basic sports in the Olympic Games, which confirms the importance of this sport in the sports world. (Al-Dulaimi et al., 2015, 11)
In order to achieve global levels in volleyball, it is necessary to pay attention to all the characteristics that help in this, and we must identify the most important of these characteristics and develop them in volleyball players in a balanced manner, by developing their abilities and skills in a way that contributes to achieving high sports levels. (Zaki, 2011, 22)
According to Taha (1999), experts confirm the impossibility of reaching the level that qualifies for the championship without finding the necessary foundations in the early stages of life. The model specifications (MODELS) for high-level players are also indicators that can be used as a guide in directing and selecting players, so that it is preferable for the main reference in selection to be for three factors: body composition, physical and functional efficiency, and psychological characteristics. (Taha, 1999, 272)
Because sports selection is the guaranteed way to create sports excellence, leading to building a champion or a team with a high level in this sport. (Taha, 1999, 273)
Selection is choosing the best elements that have a set of components and determinants, whether inherited or acquired, to join the practice of a specific sport, and predict the extent of the impact of the training process in the future, and achieve the best high sports levels. (Abbas, 2005, 63)

2. Research Problem:

Achieving high levels in sports requires comprehensive and integrated scientific foundations, as these foundations depend on accurate and correct scientific planning in selecting emerging talents, and based on the nature of volleyball, which requires special physical and bodily specifications, the scientific approach must be adopted in selecting players, so selecting and training emerging talents is considered one of the most important steps that must be taken care of, as this process effectively saves effort, time and money.

Through the researcher's interaction with coaches, specialists, and even players and players' parents, he was surprised by the lack of scientific standards and foundations for the selection process in the first place, as reliance is mostly on abstract observation during matches.

Accordingly, the researchers decided to study this topic in order to identify the most important body measurements that must be available to volleyball juniors, in order to help coaches and volleyball specialists and move away from self-selection and work on selection based on scientific foundations in order to achieve the best results. From this, the research problem was revealed in the following questions: What are the most important body measurements that must be available to junior volleyball players aged (09-12) years, how are they measured and what are the most appropriate methods of applying them in the selection process?

3. Research objectives:

1- Identify the most important body measurements that must be available to junior volleyball players aged (09-12) years in order to use them in the selection process.

2- Build levels for these measurements from very low to very high.

3- Draw a side-shape network in order to use it in the selection process of juniors in volleyball.

4. Research areas:

The researchers used the "descriptive survey method" approach to suit the nature of the research.

Human field:

The research sample included (43) players from the junior category aged (09-12) years in volleyball, representing 20% of the research community and (07) for the exploratory experiment in the states of Constantine and Mila, active in the following clubs:

- Constantine Railway Club 12 (CACC) players.
- Ain Smara Sporting Club 11 (SAS) players.
- Cirta City Olympic Club 9 (OMC) players.
- Tajnanet Sports Club 11 (EST) players.

Temporal field: The final measurements and tests were conducted during the period from 02/05/2017 to 04/17/2017

Spatial field: Training halls of the sports clubs under study

5. Measurements used in the research:

The researchers used the following while collecting data in their research:

1. Arabic and foreign sources and references to determine the most important physical indicators in volleyball
2. Personal interviews with volleyball specialists
3. Measurements used to determine physical measurements
4. Journals, scientific research and previous studies.

6. Tools and devices used in the research:

1. Medical scale.
2. Measuring tape.
3. Compass.
4. Adhesive tape (5 cm).
5. Stick, ruler, whistle, timer.
6. Ink, chair, belt, mat.

7. Determining the body measurements of volleyball players aged (09-12) years:

(16) important body measurements were determined for junior volleyball players, represented by:

05 measurements of lengths, which are: total body length, torso length from sitting, arm length, leg length, palm length, and 06 measurements of circumferences, which are: normal chest circumference, waist circumference, contracted humerus circumference, forearm circumference, thigh circumference, leg circumference, and 04 measurements of symptoms, which are: shoulder width, chest width, hip width, knee width, in addition to body weight.

8. Statistical methods:

For statistical processing, the researchers used the statistical package (SPSS) to extract the following:

Descriptive statistics: represented by the arithmetic mean, standard deviation, and skewness coefficient.

Relational statistics: Pearson's simple correlation coefficient was used.

Factor analysis: The following steps were followed to conduct the factor analysis:

Extracting the inter-correlation matrices:

This is done by calculating the correlation coefficients using Pearson's simple correlation coefficient between the research variables (anthropometric measurements) and recording them in a matrix, as in our research the correlation coefficient becomes significant at a degree of freedom (27) if its value is equal to or greater than (0.380) at a significance level of (0.01), and (0.294) at a significance level of (0.05). (Al-Takriti and Al-Ubaidi, 1999, 324)

Extracting factors before rotation:

We used the method of the principal components of Hutling (Composantes Principales) to extract the factors from the correlation matrix, which is one of the most widely used methods in factor analysis, as it is characterized by its acceptance of the criterion of "Henry Kaiser" proposed by Gutman, which depends on extracting the factors whose latent root is less than one. (Hassanein and Sobhi, 1996, 271, 273)

Extracting factors after rotation:

We used orthogonal rotation using the Promax method to reach clearer results than the initial analysis (factor matrix before rotation), as it is considered one of the most common types of rotation, as Fleishman says that it is one of the best rotation methods suitable for analyzing physical abilities. (Hassanein and Mohamed Sobhi, 1996, 273)

9. Constructing the levels of the side shape:

1. In the first column, the sequence of anthropometric measurements that will form the side shape is placed.
2. In the second column, the anthropometric measurements that make up the profile are placed, which have been filtered through the anthropometric measurement factors.
3. (07) Consecutive columns after the columns of sequence and measurements, representing the levels of the side shape of the anthropometric measurements and are calculated as follows:

A. The main column that represents the average level of anthropometric measurements and physical and physiological tests, which is the sixth column.

B. The upper limit of the sixth column is the arithmetic mean of the measurement or test (+½) the standard deviation of the same measurement or test.

C. The lower limit of the sixth column is the arithmetic mean of the measurement or test (-1/2) the standard deviation of the same measurement or test.

D. The upper limit of the columns to the right of the average level column (4,3, 5) according to the order is the upper limit of the previous column in the order directly by adding (0.01).

E. The lower limit of the columns to the right of the average level column (4,3, 5) according to the order is the arithmetic mean of the sample plus (A1,A2,A3) in order.

A. The upper limit of the columns to the left of the average level column (7,8,9) in order is the lower limit of the column immediately preceding it in the order shown plus (0.01).

G. The lower limit of the columns to the left of the average level column (7,8,9) in order is the arithmetic mean of the sample plus (1p,2p,3p) in order.

10. Drawing the side shape network:

When drawing the side shape network, its columns must correspond to the columns of the side shape levels. It is also possible to place the measurements of an individual or the arithmetic mean of a group. The measurements are indicated in the middle of the columns and according to the location of each level
according to what corresponds to it in the levels of the side shape determined in advance.

Connect the points of the individual or group, and we have the side shape network for the individual or group, and thus we can know the level and characteristics of the anthropometric measurements and the physical and physiological characteristics of the research sample on the basis of which the levels of the side shape were built. (gasmi, 2012, 88)

Table (01) shows the descriptive statistics for anthropometric measurements.

Variables	Unit of measure	skewness coefficient	standard deviation,	mean	Variable symbol
Body length	cm	0.10	9,26	143,00	XM01
Body weight	kg	0.14-	3,55	44,19	XM02
Torso length	cm	0.14-	4,58	73,58	XM03
Arm length	cm	,010	4,43	63,68	XM04
Leg length	cm	,140	5,12	73,49	XM05
Hand length	cm	,360	1,51	16,22	XM06
Upper arm circumference	cm	,610	2,87	22,83	XM07
Forearm circumference	cm	,520	2,22	20,80	XM08
Chest circumference	cm	,730	6,76	68,80	XM09
Waist circumference	cm	,510	6,47	63,91	XM10
Thigh circumference	cm	,460	4,68	40,64	XM11
Legging circumference	cm	,300	3,24	29,21	XM12
Shoulder width	cm	0.25-	2,81	29,87	XM13
Chest width	cm	,730	2,053	22,02	XM14
Pelvis width	cm	,360	2,27	23,39	XM15
Knee width	cm	,0250	0,68	8,90	XM16

From the above table, it is clear that all values of the skewness coefficient range between (-1) and (+1), which indicates the moderation of the anthropometric measurements used in the study.

11. Results of factor analysis after orthogonal rotation:

During the stage of using orthogonal rotation using the (Promax Kaiser) method, (02) factors were reached, the percentage of variance explained for them reached (68.58), and according to the conditions for accepting the factors and the criteria for simple construction, the two factors were accepted, and Table (10) shows that.

.**Table (02) shows the factor matrix for anthropometric measurements after rounding for young people**

Factors				Variables
T	2	T	1	
		3	0,91	XM01
7	0,79			XM02
	0,35	9	0,63	XM03
		2	,940	XM04
		1	1,03	XM05
		6	0,76	XM06
1	0,97			XM07

4	**0,92**			**XM08**
6	**0,82**			**XM09**
2	**0,96**			**XM10**
3	**0,93**			**XM11**
5	**0,83**			**XM12**
		5	**0,82**	**XM13**
		8	**0,71**	**XM14**
		7	**0,75**	**XM15**
		4	**0,82**	**XM16**

.XM = (x01, x16): represents the anthropometric measurements used in the study

Through the results of the factor analysis, (02) factors were reached and were interpreted as follows:

Interpretation of the first factor:

Through Table (02) which represents the factor matrix for anthropometric measurements of volleyball juniors after rotation, it is clear that the number of variables that were saturated on the first factor is (09) variables representing (56.25%) of the total number of variables, which is (16) variables, as these saturations were positive, and they were arranged in descending order according to the absolute saturations as follows:

1. Leg length 1.03 (XM05)
2. Arm length 0.94 (XM04)
3. Total body length 0.91 (XM01)
4. Knee width 0.82 (XM16)
5. Shoulder width 0.82 (XM13)
6. Palm length 0.76 (XM06)
7. Pelvis width 0.75 (XM15)
8. Chest width 0.71 (XM14)
9. Torso length 0.63 (XM03)

By arranging the saturations, it is clear that the variables that were saturated with the first factor are (05) measurements specific to length at a rate of (100%) as well as (04) measurements specific to width at a rate of (100%).

It is clear from the saturations observed on this factor that it is a sectarian factor, as the percentage of factorial variance explained by the first factor reached (84.86%), as the measurements were saturated with positive values. The researcher believes that this factor can be called the longitudinal factor, as this factor topped the measurement of leg length with the highest saturation of (1.03), followed by arm length with a saturation of (0.94), then the total body length with a saturation of (0.91), and the research team nominates these measurements as one of the bases for selecting volleyball juniors aged (09-12) years.

Interpretation of the second factor:

Through Table (10) which represents the factor matrix for anthropometric measurements of volleyball juniors after rotation, it is clear that the number of variables that were saturated on the second factor is (07) variables representing (43.75%) of the total number of variables, which is (16) variables, as these saturations were positive, and they were arranged in descending order according to the absolute saturations as follows:

1. Arm circumference (XM07) 0.97
2. Waist circumference (XM10) 0.96

3. Thigh circumference 0.93 (XM11)
4. Forearm circumference (XM08) 0.92
5. Leg circumference 0.83 (XM12)
6. Chest circumference 0.82 (XM09)
7. Body weight 0.79 (XM02)

By arranging the saturations, it is clear that the variables that were saturated with the second factor are (06) Measurements specific to the circumferences at a rate of (100%) and one measurement specific to weight. It is clear from the observed saturations on this factor that it is a sectarian factor, as the percentage of factorial variance explained for the second factor reached (15.13). It is noted that the measurements of the circumferences distributed into two groups were saturated on this factor, the first for the upper part of the body, which is the circumference of the arm - the circumference of the waist - the circumference of the forearm - the circumference of the chest, and the second group for the lower part of the body, which is the circumference of the thigh and the circumference of the leg, as the research team believes that this factor can be called (the circumference factor).

This factor topped the measurement of the circumference of the arm with the highest saturation of (0.97), followed by the circumference of the waist with a saturation of (0.96), followed by the circumference of the thigh with a saturation of (0.93), and the research team also nominates these measurements as one of the bases for selecting volleyball juniors aged (09-12) years. Nominating anthropometric measurements for the extracted factors:

Through the above presentation of the results of the factor matrix after rotation using the Promax Kaiser method for the anthropometric measurements of junior

volleyball players aged (09-12 years), the anthropometric measurements were nominated for the units of the lateral shape network, and Table (03) shows that**:**

Table (03) shows the variables of the factors nominated from the factor analysis.

Name of Factor	Factor	Unit of Measure	Measurements	Order
Longitudinal body	First	centimeter	Leg length	1
Longitudinal body	First	centimeter	Arm length	2
Longitudinal body	First	centimeter	Total body length	3
Circular body	Second	centimeter	Upper arm circumference	4
Circular body	Second	centimeter	Waist circumference	5
Circular body	Second	centimeter	Thigh circumference	6

Table (04) shows the levels of the units of the extracted factors in terms of anthropometric measurements.

Very low level	Low level	Below average level	Average level	Above Average level	average level	level High level	Levels / Filtered Measurements	T
63.24	68.36	70.92	76.05	78.61	83.73	88.85	Leg Length	1
58.13	63.25	68.37	70.93	76.06	78.62	83.74		
54.81	59.24	61.46	65.89	68.11	72.54	76.97	Arm Length	2
50.39	54.82	59.25	61.47	65.90	68.12	72.55		
124.47	133.73	138.36	147.63	152.26	161.52	170.78	Total Body Length	3
115.22	124.48	133.74	138.37	147.64	152.27	161.53		
17.12	19.95	21.39	24.26	25.70	28.57	31.44	Upper Arm Circumference	4
14.26	17.13	19.96	21.40	24.27	25.71	28.58		
50.96	57.43	60.67	67.14	70.38	76.85	83.32	Waist Circumference	5
44.50	50.97	57.44	60.68	67.15	70.39	76.86		
31.27	35.95	38.29	42.98	45.32	50.00	54.68	Thigh Circumference	6
26.60	31.28	35.96	38.30	42.99	45.33	50.01		

12. Discussion:

The results of the body measurements of junior volleyball players aged (09-12) years were discussed, nominated through factor analysis, for which levels were built and a side-shape network was drawn in order to establish a scientific basis that helps coaches and specialists in the process of selecting junior volleyball players in a scientific manner.

The leg length factor topped the ranking in terms of anthropometric measurements, which is consistent with what was reached by Haddadi's study (2013), as leg length obtained first place, which clearly indicates the importance of leg length for a volleyball player, while it did not match it in arm length, as it was not accepted among the important anthropometric measurements in the selection process for juniors. Also, with regard to leg length and total body length, Bouslimi and Pineau (2001) indicate that the growth spurt affects different parts of the body in a regular order, as the lower limbs begin to grow to their maximum degree first. (P,82)

Also according to Malina and Bouchard (2004), the growth of the lower limbs is faster than the growth of the trunk (P,70). Also, Ahmed Akour's study (2015) stated that the most important physical measurements for selecting juniors in volleyball are the length of the legs and the length of the arms, which also appeared in our study, as the length of the arm ranked second with the second highest saturation on the first factor, to also agree with the study of Shasho (2021) and the study of Al-Hamri (2002), where the length of the arms

came in first place and was accepted. On the other hand, the length of the leg did not agree with this study, as the length of the leg was not chosen as a criterion for selection among juniors in volleyball.

The research team believes that the length of the arm has a very important role in the strength and effectiveness of performance, as it is a lever, which causes the generation of a greater amount of force, because the player who has a longer arm has a stronger weighted force on the arms than the player who has a short arm, and therefore the longer arm will be more influential in the jump.

This is why the research team also attributes the importance of the total body length and the length of the lower and upper limbs in volleyball, as the longer the player is, the more effectively he can perform skills such as crushing, blocking, and directing balls towards the opponent's area.

As for the circumference of the upper arm, it also agrees with what was stated in the study of Haddadi (2013), as the circumference of the upper arm was chosen from among the important anthropometric measurements in the process of selecting juniors in volleyball, while the circumference of the upper arm was not accepted in the study of both Al-Talahama (2007) and Al-Hamri (2002).

The research team attributes the importance of this indicator to young people due to the nature of using the arm in all volleyball skills, so the circumference of the upper arm has a direct relationship with arm strength, as it is considered one of the most important indicators of energy and health, as Khuraibet (1989) indicates that the larger the cross-section of the muscle, the greater the muscle strength, which helps the player to hit the ball. (p. 22) Rattel and Martin (2014 Ratel & Martin,) also explain that the strength of the upper limbs begins to increase significantly during the end of childhood and the beginning of early adolescence, and this coincides with the increase in body mass. (P, 32)

Since in the skill of sending as well as the skill of crushing in addition to the process of blocking as well as passing the ball to a colleague, the presence of a strong humerus muscle is required. In addition to this, the humerus muscle has a direct role during the arm swing because it gives greater strength to the arms, which contributes effectively to the process of jumping and rising upwards, which is confirmed by the study of Maha Sabry and others (2008), where they found a strong connection between the circumference of the humerus and the skill of crushing, so it is recommended to include special exercises to strengthen this muscle during preparatory training. As for the waist circumference, it did not match what was mentioned in all previous studies, but the research team believes that it is of great importance to players of various sports and volleyball players in particular because it is related to the body type. The smaller the circumference, the closer the body type is to being muscular or thin. This certainly contributes clearly to the player’s performance, whether from a physical perspective, as he is often characterized by speed in performance and movement, greater agility and the ability to rise. This contributes to the player’s technical performance, whether in defensive skills such as receiving the ball or defending, as well as rising and performing the blocking skill, as well as in offensive skills in the smash hit, which requires speed in performance, the ability to rise and agility to perform the technique effectively. As for the thigh circumference, it is consistent with what was stated in the study of Shasho (2021), while it did not agree with what was stated in the rest of the studies. The research team attributes the emergence of this indicator among the first three factors with the highest saturation to the nature of using the legs in jumping, running and movements inside the field, which requires the presence of muscles characterized by strength, as the research team believes that the higher this indicator (thigh circumference), the greater the strength it gives. Also, the thigh circumference is related to the strength of the lower limbs as it helps in performing jumps, quick movements and movements inside the field, because volleyball is a sport that requires its players to have lower limb muscles in general and a thigh muscle in particular that has the ability to contract and great strength because this is one of the requirements of the game, which is characterized by quick and successive movements and jumps.

13. Conclusions:

Through this descriptive study that aims to identify the most important body measurements in order to use them in selecting volleyball juniors aged (09-12) years, the following was reached:

Three measurements of lengths were accepted, represented by: leg length, arm length and total body length, and three measurements of circumferences, represented by arm circumference, waist circumference and thigh circumference. Based on the results of the obtained anthropometric measurements, seven (07) levels were built for each measurement from very low to very high through specific areas, which are shown in Table (04).

The side shape network (profile) was also drawn in terms of the anthropometric measurements that were accepted, which is considered a tool for evaluating the anthropometric aspect of volleyball juniors aged (09-12) years to assist in the selection process.

14. Study Prospects:

Through the results reached, the researchers recommend the following:

1. Guided by the anthropometric measurements that have been nominated and have a high saturation on the factors, namely: leg length, total body length, arm length, upper arm circumference, waist circumference, thigh circumference, and adopting them in the selection process for juniors with regard to the physical aspect.
2. Conducting more similar research at different age groups and in several sports in order to benefit from the results in selecting the best elements for these sports.
3. Taking into account the physical measurements while starting the process of developing training plans and educational programs for volleyball juniors.
4. Using standard levels to evaluate anthropometric measurements for scientific evaluation.
5. The necessity of making cards to record the data of each junior to identify the physical, physical, health, physiological, skill and psychological condition in an attempt to track the changes that occur in these different aspects.

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