The Sankalpa: International Journal of Management Decisions
ISSN: 2454-7425
Volume 12, Issue (July - December 2026)

Extracting The Factor Structure of Specific Physical Abilities for the Selection Process in Volleyball Players Using Exploratory Factor Analysis Applications

Ahmed Lebchiri
Institute of Sciences and Techniques of Physical and Sports Activities
University M'sila, Algeria, ahmed.lebchiri@univ-msila.dz
Abdennour Ouali
Institute of Sciences and Techniques of Physical and Sports Activities
University M'sila, Algeria, abdennour.ouali@univ-msila.dz
Yazid Amour
Institute of Sciences and Techniques of Physical and Sports Activities
University Alger3, Algeria, amour.yazid@univ-alger3.dz
*Correspondence: Ahmed Lebchiri, e-mail: ahmed.lebchiri@univ-msila.dz

Recieved : 11/04/2026 Accepted : 20/06/2026 Published : 15/09/2026

Abstract
The Object of the study aims to extract the most important physical abilities associated with the selection process for volleyball players through exploratory factor analysis (EFA) and to identify the factor structure that explains individual differences in performance levels among players, To determine the basic structure of the factors, including the variables before and after factor rotation, and their impact on the practical and methodological applications of volleyball selection processes. for this purpose, we used the descriptive method On a sample composed of (70) volleyball players selected by a simple random method, and for data collection, we used A set of Physical Abilities tests After collecting the results and having treated them statistically, The study concluded that are three main factors (strength, speed, and agility) based on eigenvalues and the magnitude of variable loadings on their respective factors. These factors represent essential components in the selection process in volleyball and have a direct impact on the skill performance of volleyball players.
Keywords :
Physical Abilities, Selection , Exploratory Factor Analysis (EFA)

1. Introduction

Physical abilities related to volleyball constitute an important element in achieving optimal athletic performance through the interaction of variables with skill performance. It is considered one of the disciplines that requires a comprehensive set of physical requirements directly related to the performance of a volleyball player. These requirements include the physical and physiological attributes of the player.The specific physical requirements are one of the most important aspects necessary for mastering motor skills to reach the required technical performance

and are closely related to the player's motor abilities, through the set of functional abilities required for high athletic performance (Salama Ibrahim, 2000, p2). Preparation for the specific physical aspect helps to develop the player's specific physical and functional abilities to accustom his body adapting to high physical exertion and playing conditions (Adel Majeed Khazal, 2015, p. 21).The selection process in volleyball is one of the most crucial stages, as it relies on identifying the fundamental physical abilities that effectively contribute to players skill and tactical performance. Despite the existence of numerous physical tests, determining the most influential abilities for a player's success remains a subject of debate among researchers and coaches, especially given the interplay of variables, the difficulty in defining their underlying structure, and the complex relationships between them.This renders traditional selection methods of limited effectiveness, despite the multitude of physical tests used to assess these abilities by identifying the key factors affecting athletic performance, due to the overlap and interaction of these variables.

In this regard, exploratory factor analysis (EFA) provides a scientific framework capable of identifying the underlying structure of physical abilities by extracting the most common factors that contribute to explaining the variance between tests.This allows for reducing the number of variables and arriving at a focused set of core abilities. Recent studies also indicate that the use of factor methods can help in building more scientifically accurate selection systems compared to descriptive methods (Kline, 2016). Alawi and Abu Al-Ala (1997) pointed out that factor analysis contributes to revealing the true factor structure of physical requirements by grouping similar variables into independent factors. This enables the extraction of the most important abilities affecting the athletic performance of a volleyball player. Hassanin (2004) indicated that using this method provides a scientific basis for selecting appropriate physical tests according to scientific and statistical rules. Traditional tests, despite their importance, do not always provide an accurate picture of the interrelationships between physical abilities because many of these variables overlap in a way that is difficult to disentangle using descriptive statistical tools. This makes the process of identifying the most important physical abilities upon which athletic selection is based a complex process. Advanced statistical tools are required that are capable of revealing the underlying structure of the variables. This analysis is also distinguished by its ability to handle large datasets and uncover underlying dimensions that cannot be directly perceived, making it highly suitable for studying the interconnected physical abilities of volleyball players. Despite the increasing use of factor analysis, its applications in the sports field, particularly in volleyball, remain limited and lack coherent objectives. Some studies reveal a clear disparity in the nature of the abilities extracted and the number of determining factors, in addition to variations in data collection and analysis methodologies. This renders the results of previous studies insufficient for constructing a unified model that can be relied upon for athletic selection. Furthermore, most studies have not addressed physical abilities from a comprehensive structural perspective but have focused on certain tests to the exclusion of others, which limits their ability to provide a complete picture based on the factor structure of the variables.

Therefore, a volleyball player needs a set of integrated physical abilities such as explosive leg and arm power, agility, reaction speed, dynamic balance, endurance, flexibility, and other variables whose importance varies depending on the player's position within the team. However, the degree to which these abilities contribute to performance varies from player to player, as do their interrelationships. This makes it necessary to rely on a statistical method capable uncovering the underlying structure shared by these variables and identifying the most important ones objectively and accurately.

Accordingly, the transition from traditional methods of sports selection to structural analysis methods represents a necessary scientific step towards developing local standard models that take into account the physical and physiological characteristics of players in our environment. Hence, the urgent need to study the applications of exploratory factor analysis in this subject is evident, with the aim of identifying the most important physical abilities that are actually related to selection in volleyball and presenting a model that can be applied in sports selection processes. On this basis, the researcher poses the following question: What are the most important latent physical abilities that can be extracted using exploratory factor analysis and how can they be employed in building a scientific model that contributes to the selection process for volleyball players?

2. Study Hypotheses:

The most important physical abilities associated with the selection process for volleyball players can be identified and extracted through the basic component structure of exploratory factor analysis applications.

The results of exploratory factor analysis can reveal a set of interrelated physical factors that can explain a high percentage of the common variance among the physical tests of volleyball players.

- The selected physical tests can be distributed across a limited number of basic factors, and some physical abilities may be more influential than others in determining the factor structure, qualifying them as key indicators in the athletic selection process in volleyball.

3. Study Objectives:

- To extract the most important physical abilities associated with the selection process for volleyball players through exploratory factor analysis (EFA) and to identify the factor structure that explains individual differences in performance levels among players.
- To determine the basic structure of the factors, including the variables before and after factor rotation, and their impact on the practical and methodological applications of volleyball selection processes.
- To compare the factor structure of physical abilities according to playing positions and competition levels for volleyball players.

4. Concepts and Terminology:

4.1. Exploratory Factor Analysis (EFA):

Exploration factor analysis is one of the most important multivariate statistical methods that aims to identify and discover the underlying structure of a set of studied variables. This is

achieved by identifying common factors that explain the correlation between them without presupposition. Researchers use this method when the goal is to explore the underlying factors or characteristics of a variable (Fabrigar & Wegener, 2012). Exploratory factor analysis reduces the number of variables by combining them into a smaller number of factors that have the greatest ability to explain the common variance between the variables. This is done using a correlation matrix to estimate the strength of the relationship between the variables (Hair et al., 2019). This analysis is a fundamental tool in psychological, educational, and social research because it helps to reveal the theoretical structure embedded in the data in a non-specific or non-directional way, unlike confirmatory factor analysis, which requires a presupposed model (Kline, 2016).

4.2. Physical abilities:

Many scientists and experts agree on identifying the most important components of physical abilities necessary for practicing sports activities and developing an individual's athletic level, despite the different names given to them, such as physical attributes, physical abilities, motor abilities, physical fitness, and physical conditioning. These components are: muscular strength, muscular endurance, speed and agility, psychomotor endurance, flexibility and coordination, balance, and precision. (Ahmed Fares Mohammed Saleh, 2011, p. 17)

4.3. Selection in the Sports Field:

This is considered the first step for talented young athletes on the ladder of success in their championships and activities. Selecting young athletes for this category of regular sports practice means choosing the best individuals who possess specific aptitudes that allow for predicting their potential to reach high athletic levels.

It is also defined as a process aimed at selecting individuals who possess the significant characteristics, traits, abilities, and aptitudes required by the nature of their athletic development. (Ben Koua Ali, 2003/2004, pp. 35-36).

4.4. Evaluation in the Sports Field:

Evaluation refers to a systematic process with varying structures for collecting information, observations, and analyses that culminate in a judgment regarding the quality of the thing being evaluated (Brahimi Issa et al., 2018, p. 188). Evaluation can include multiple methods and diverse tools, some of which rely on quantitative measurement, while others rely on qualitative assessments and descriptive judgments, all for the purpose of selecting individuals. (Amoura Yazid, 2023, p. 168).

5.Methodological Procedures of the Study:

5.1. Study Methodology: The researcher adopted the descriptive method as it was suitable for the nature of the problem at hand. This method aims for systematic scientific analysis and interpretation to describe a specific phenomenon or problem and portray it quantitatively by

collecting, classifying, analysing, and subjecting data and specific information about the phenomenon or problem to rigorous study. (Ali Muammar Abdul-Mumin, 2008, p. 287)

5.2 Study Population: The study population refers to all the elements to be studied. Selecting a portion of the study population is called sampling, and the process carried out in this way is called sampling. (Mundhir Abdul-Hamid Al-Dhamin, 2007, p. 160) This includes all volleyball players at all levels (senior category) in the state of M'Sila.

5.3.Study Sample: This is a part of the population selected according to specific rules to ensure the sample is as representative as possible of the study population (Mohammed Abdel Aal Al-Nuaimi et al., 2015, p. 78). The researcher indicates that the sample was selected by a simple random method, which falls under probability sampling. The sample size was (70) volleyball players, encompassing all levels from (5) different clubs.

5.4.Study tools: Each study is based on a set of foundations and tools to collect information about the subject of the study in order to achieve the study's objectives (Bashiri Ahmed, 2021, p. 107). Determining the physical abilities specific to volleyball requires identifying the sources of all its classifications in the context. Determining its appropriate tests requires a set of procedures to identify the best tests in all aspects. A set of tests has been identified that represent, in its first reference, the physical abilities specific to the volleyball player. A set of tests that measure the explosive power of the legs and arms has been adopted, in addition to the agility test specific to volleyball players and the two tests of reaction speed and neuromuscular coordination.

5.5.The statistical methods used in the study :aim to extract significance for all tests so that researchers can make judgments based on the results obtained. Accordingly, some descriptive statistical indicators and correlation coefficients were extracted, in addition to exploratory factor analysis (EFA) using the SPSS program.

6. /Presentation, Analysis, and Discussion of Results:

1.6/ Presentation of the Descriptive Statistical Indicators for Physical Test Results among Volleyball Players:

Table (01) represents: the values of some descriptive statistical indicators for the physical test results of the study sample *(n=70*

Statistical variables	*Mean*	*Std.Error*	*Std.Deivation*	*Skewness*
Leg explosive power	**47.53**	**0.520**	**5.700**	**2.884**
Arm explosive power	**19.35**	**0.366**	**4.010**	**-1.252**

Neuromusculaire coordination	**11.31**	**0.110**	**1.214**	**2.651**
Transitional speed	**3.15**	**0.014**	**0.161**	**2.778**
Reaction speed	**1.55**	**0.010**	**0.110**	**1.734**
Truncus flexibility	**28.34**	**0.804**	**8.816**	**2.341**
Shoulder flexibility	**53.35**	**0.548**	**6.006**	**2.550**
Agility	**8.57**	**0.044**	**0.489**	**-0.453**
Endurance	**12.98**	**0.046**	**0.506**	**0.164**

The table results indicate descriptive statistical indicators, providing an accurate statistical picture of all data obtained from the physical fitness tests of the study sample (n=70). This allows the researcher to draw all possible inferences, which is a fundamental indicator in the application of all statistical tests.

The mean values for the physical fitness results were within the statistical range of 1.55–53.35, maintaining all units for each test methodologically and statistically, with a standard error of ±0.010 for the mean within the range of ±0.804. Regarding the skewness coefficients, the skewness coefficient for physical fitness was within the range of ±0.453–2.884. Therefore, these descriptive statistical data form the core for conducting subsequent tests, serving as a descriptive indicator that can be relied upon to interpret some of the variables related to the study, based on the results obtained for the physical fitness values.

6.2.Presenting the correlation matrix values between physical tests among volleyball players:

Factor analysis seeks to uncover a relatively small number of underlying variables that represent the interrelationships between a large number of measured variables (Mohammed Bouziane Tighza, 2012, p. 17), in addition to the condition related to the plausibility of the correlation matrix and the adequacy of the sampling, where (0.50 < MSA) (Yachkour Abdel Nour et al., 2021, p. 311**)**

Table (02) represents the values of the inter-variable correlation matrix between the variables among volleyball players.

Variables	1	2	3	4	5	6	7	8	9
Leg explosive power	1.000	0.758	0.429	0.118	0.801	0.840	0.245	0.705	0.291
Arm explosive power		1.000	0.307	0.068	0.425	0.515	0.203	0.298	0.080
Neuromusculaire coordination			1.000	0.047	0.353	0.489	0.316	0.400	0.307
Transitional speed				1.000	0.204	0.228	0.303	0.200	0.345
Reaction speed					1.000	0.865	0.171	0.845	0.447
Truncus flexibility						1.000	0.256	0.824	0.445
Shoulder flexibility							1.000	0.263	0.142
Agility								1.000	0.624
Endurance									1.000
The Determinant of Correlation Matrix = 0.001									

The table above shows the correlation matrix values for the physical tests of volleyball players (n=70), with 36 intervariates. The linear correlation coefficients can be observed, and for factor analysis to be valid, most of the matrix coefficients should have R > 0.30.

To ensure the absence of multicollinearity among the variables, the determinant of the correlation matrix was set to 0.001, which is greater than the criterion value (0.00001). This means that an inverse of the matrix can be found, allowing for exploratory factor analysis (EFA). The Measures of Sampling Adequacy (MSA) values and their suitability for each variable are greater than 0.50, as determined by the MSA values within the anti-image matrices. It should be noted that to proceed with subsequent exploratory factor analysis steps, the correlation matrix values must first be examined using the KMO test to measure sample

adequacy and the Bartlett test to measure the minimum correlation between the correlation matrix values.

6.3. Indicators of Sample Size Adequacy According to the Kaiser Criterion in the Study Variables:

This test aims to determine the adequacy of sample size using the Kaiser-Meyer-Olkin (KMO) Test (Saad bin Saeed Al-Qahtani, 2015, p. 284), the value of which must be greater than 0.50

Table (3): represents the values of the indicators of sample size adequacy and measurement quality according to the Kaiser criterion for the study sample.

Statistical variables	*Approx. Chi-Square*	*df*	*P-value*
Bartlett's Test of Sphericity	**767.129**	**36**	**0.000**
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	**0.774**		
(KMO>0.50)			

The table indicates the values of the sample size adequacy and measurement quality indices according to the Kaiser criterion. The sampling accuracy index (KMO) reached 0.774, which is greater than 0.5, meaning that the sample size is sufficient for factor analysis. This aligns with Kaiser's requirement that values greater than 0.50 are acceptable (Abu Bakr Bakhtawi, 2019, p. 277).

This demonstrates the high accuracy of the partial sampling, as evidenced by the overall sampling accuracy index (KMO) value of 0.774, which exceeded 0.7. Values between 0.7 and 0.8 are considered good according to the overall sample adequacy index. Therefore, the data are suitable for factor analysis to extract the underlying factors representing physical abilities.

6.4.Eigenvalues and explanatory power of the factors (physical abilities) before rotation:

Table No. (04): Represents the eigenvalues and explanatory power of the factors before rotation for the results of the variables

Component	*Initial Eigenvalues*			*Extraction Sums of Squared Loadings*		
	Self-values	*Explained variance ratio*	*Combined variance ratio*	*Self-values*	*Explained variance ratio*	*Combined variance ratio*
01	**4.493**	**49.926**	**49.926**	**4.493**	**49.926**	**49.926**
02	**1.290**	**14.329**	**64.255**	**1.290**	**14.329**	**64.255**
03	**1.065**	**11.829**	**76.083**	**1.065**	**11.829**	**76.083**
04	**0.836**	**9.286**	**85.369**			
05	**0.579**	**6.437**	**91.806**			
06	**0.435**	**4.834**	**96.640**			

07	**0.116**	**1.284**	**97.924**	
08	**0.108**	**1.197**	**99.121**	
09	**0.079**	**0.879**	**100**	

The table above represents the first step in identifying the factors extracted from these variables. These factors can be extracted into three factors before rotation, meaning the matrix can be interpreted using these factors. This is determined by the latent root values (Eigenvalues), all of which were greater than (1). The latent roots of the factors are shown, indicating the size of the extracted or interpreted variance by each factor and the percentages of the cumulative variance within the overall ratio of 76.08 to the determinants of selection for the volleyball player.

6.5.Variable loads on factors after rotation of study data:

Table No. (05) represents the variable loads on factors after rotation of the study sample data.

Variables	First factor	The second factor	The third factor
Leg explosive power	**0.871**		
Arm explosive power	**0.856**		
Neuromuscular coordination	**0.689**	**0.635**	
Transitional speed	**0.522**		
Reaction speed		**0.825**	
Truncus flexibility		**0.810**	
Shoulder flexibility	**0.595**	**0.711**	
Agility			**0.828**
Endurance			**0.699**
Extraction Method: Principal Component Analysis.			
Rotation Method: Varimax with Kaiser Normalization			

The table above shows the factor loads on the factors after rotation of the study data, which yielded three main factors. Each factor consists of a set of variables with a criterion value of 0.60. Principal component analysis with orthogonal rotation (Varimax) resulted in the extraction of three main factors that explain the factor structure of the studied physical abilities. The first factor is physical strength, which recorded the highest loads for the variables of explosive power in the lower and upper limbs. The second factor is speed, neurological

efficiency, and flexibility, as evidenced by high loads for reaction speed and trunk and shoulder flexibility.

The third factor is agility and endurance, with agility recording the highest load. These results indicate the integration and interrelationship of physical abilities in achieving optimal athletic performance.

Using Principal Component Analysis (PCA) with orthogonal rotation using the Varimax method contributed to improving the clarity of the factor structure and the independence of the factors. The presence of dual saturations for some variables (such as neuromuscular coordination and shoulder flexibility) indicates their composite nature and their impact across multiple physical dimensions.

The number of extracted factors (3) aligns with the criterion of intrinsic value and the validity of the matrix for exploratory factor analysis. The results of the exploratory factor analysis in this study are consistent with studies that identify a multidimensional structure of the components of physical fitness and motor performance (Jessica B. Farley et al., 2020).

Study results:

*****The exploratory factor analysis of the physical abilities of volleyball players revealed three main factors, all of which exceeded the Kaiser criterion (elemental value > 1), indicating that they represent meaningful structural dimensions in the physical performance of the players. The total variance explained by these factors amounted to 76.08%, which is an indication of the success of the factor model in explaining the underlying structure of physical abilities.

*****These factors can be used as a standard framework to select the player according to the abilities that most affect performance in volleyball. In addition, sports selection should focus on these factors instead of relying on individual physical tests or impractical indicators. In general, the basic physical abilities of volleyball players were analyzed using a set of tests and the application of factor analysis to explore the underlying structure of physical abilities related to the selection process, and that there is a correlation in the basic structure of physical abilities through the interpretation of the proportions of common variance between the three extracted factors.

Conclusion:

Using exploratory factor analysis to extract the underlying structure of essential physical factors influencing volleyball player selection is crucial. This involves reducing and combining variables into factors based on their importance within specific statistical criteria that represent the saturation of variables on the factors.

This study aims to demonstrate how to extract the factor structure of specific physical abilities relevant to volleyball player selection using exploratory factor analysis applications. It also aims to construct a scientific model that streamlines the process and serves as a foundation for determining predictive equations and their contribution to stabilizing the extracted factors. Furthermore, it is important to emphasize the explanatory value of the combined variance

between physical abilities through the correlation matrix and determining the significance of these values. This is based on variables with a linear relationship, which allows us to analyze the contribution ratios between physical abilities to achieve high performance levels.

References:

1. Ahmed Fares Mohammed Saleh (2011): The effectiveness of a proposed program to improve the physical abilities related to the offensive strike skill among young volleyball players in Palestine, unpublished master's thesis, Faculty of Education, Al-Azhar University, Gaza.
2. Salama Ibrahim (2000): The Applied Approach to Measurement in Physical Fitness, First Edition, Al-Maaref Establishment, Alexandria.* Ali Ben Qoua (2003/2004): Determining Standard Levels for Some Basic Skills Among Junior Football Players (14-16 Years Old), Unpublished Doctoral Thesis, Institute of Physical Education and Sports, University of Mostaganem**.**
3. Ali Maamar Abdelmoumen (2008): Research in the Social Sciences, First Edition, Arab Group for Training and Publishing, Cairo.
4. Ammoura Yazid (2023): Standardizing the Test Battery in the Field of Sports Training, Specializing in Handball, Scientific Journal of Physical Education and Sports, Volume 22, Issue 1.
5. Issa Brahimi, Hasnaa Salhaoui, Fatima Zahra Zidan (2016): A Comparative Study of the Level of Health Awareness Among Students Who Participate and Do Not Participate in Physical Education and Sports Classes, Journal of Laboratory Notebooks, Volume 11, Issue 2.
6. Labshiri Ahmed (2021): The Impact of Using Mental Imagery in the Annual Physical Training Program on Improving the Physical and Skill Abilities of Volleyball Players, Unpublished Doctoral Dissertation, Institute of Physical Education and Sports, University of Algiers 3
7. Muhammad Abdul-Al, Abdul-Jabbar Tawfiq, Ghazi Jamal (2015): Methods and Approaches of Scientific Research, No Edition, Al-Warraq Publishing Foundation, Jordan**.**
8. Munther Al-Dhamin (2007): Fundamentals of Scientific Research, First Edition, Dar Al-Masirah Publishing, Amman.
9. Adel Majid, Raed Muhammad Mushtat, Nahida Al-Dailami (2015): Modern Volleyball and its Specialized Requirements, No Edition, Dar Al-Kutub Al-Ilmiyah, Beirut.
10. Saad bin Saeed Al-Qahtani (2015): Applied Statistics: Basic Concepts and Statistical Analysis Tools, General Administration for Printing and Publishing, Saudi Arabia.

11. Amhamed Bouziane Tighza (2012): Exploratory and Confirmatory Factor Analysis: Concepts and Methodology Using SPSS and LISREL, Dar Al-Masirah for Printing and Publishing, Amman
12. Mohamed Sobhi Hassanin (2001): Measurement and Evaluation in Physical Education and Sports, Part One, Dar Al-Fikr Al-Arabi, Cairo
13. Abu Al-Ala Ahmed Abdel Fattah (1997): Sports Training, First Edition, Dar Al-Fikr Al-Arabi, Cairo
14. Fabrigar, L. R., & Wegener, D. T. (2012). Exploratory factor analysis. Oxford University Press.*Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). Multivariate data analysis (8th ed.). Cengage Learning.
15. 15.Kline, R. B. (2016). Principles and practice of structural equation modeling (4th ed.). The Guilford Press.