

Utilizing Artificial Intelligence to Identify a Model for Muscular Strength and Accuracy index of Shooting Skill in Handball

Qahtan Fadhil Mohammed*, Omar Rasheed Hassan

University of Diyala

*Correspondence: Qahtan Fadhil
Mohammed
Email: qahtan.fhadel@uodiyala.edu.iq

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Abstract: *In light of rapid advancements across various fields, the domain of sports stands out for its growing emphasis on scientific planning grounded in testing and measurement. These tools play a critical role in evaluating athletes' performance and identifying their physical and technical capabilities. Periodic testing serves as an effective means of assessing these attributes and enhancing athletic performance. Within this context, artificial intelligence—particularly artificial neural networks—emerges as a sophisticated method for analyzing sports data and constructing precise models that link various performance variables. Problem of Study lies in the absence of a scientifically accurate model based on neural networks to analyze the relationship between muscular strength and shooting performance in handball. The study aims to develop a model that contributes to the scientific evaluation and development of athletes by identifying the relationship between muscular strength and different types of shooting. The researchers employed a descriptive methodology using correlational analysis. Sample consisted of (30) players from the Premier League during the 2024–2025 season. Muscular strength and shooting types were measured, and the data were processed using neural network techniques. Results demonstrated the effectiveness of neural networks in identifying*

correlational relationships and the relative importance of the studied variables. This enabled the construction of a precise model linking muscular strength to shooting types. The study recommends the application of this model in sports training and the adoption of modern statistical programs, such as neural networks, to enhance athletic performance

Keywords: *Artificial intelligence, Model, Muscular strength, Shooting, Handball*

Introduction

The world is witnessing rapid development across various domains, including the field of sports. This progress is increasingly driven by sound scientific planning and an objective approach to data collection, primarily through the use of testing and measurement at every stage of the process. Tests and measurements offer a clear representation of an athlete's performance level, allowing for comparisons with oneself or with other athletes. The advancement of physical, motor, and skill-related aspects in any sport is closely tied to the regular administration of tests, because they serve as tools for identifying an athlete's capabilities and tracking his development. Artificial intelligence (AI) is a system that simulates human intelligence to perform tasks and improve its performance based on the data it gathers. AI possesses the ability to think with exceptional precision and to analyze data in a highly accurate and comprehensible manner. Neural networks, a branch of AI and

a technique within data mining, are computational models designed to mimic the functioning of the human brain. They operate through massive parallel processing distributed across simple processing units known as neurons or nodes, which possess neural-like features.

These units store experiential knowledge and practical information, making it accessible to users by adjusting weights. The primary goal is to predict the extent to which an individual possesses specific physical attributes that enable him to perform sport-specific motor and skill tasks more effectively.

Strength is one of the fundamental and essential physical attributes in handball due to the diverse situations of the game, particularly in offensive and defensive performance. This necessitates that players maintain a high level of physical and skill performance to meet the demands of competition. Shooting is one of the critical skills in handball, serving as the culmination of physical and technical effort, scoring goals and achieving victory.

Significance of study lies in developing a model using neural networks of muscular strength as an indicator of shooting accuracy in handball. This model aims to contribute to the quantification of player performance, distinguishing handball players through their shooting and ultimately evaluate them.

Problem of the Study

Globally, there has been increasing interest in modern sciences across various fields, including physical education and sports sciences. Coaches and trainers in the sports domain rely on precise tests and reliable measurements to monitor progress and compare of athletes. Consequently, the importance of artificial intelligence—particularly neural networks—has grown as an effective tool for data analysis and more accurate prediction of athletic performance

Given the researchers' specialization in testing and measurement within the field of handball, they sought to highlight the significance of shooting skill and the physical attribute of muscular strength, because of their importance in handball. However, there is a noticeable absence of a precise model based on neural networks to analyze the relationship between muscular strength and shooting performance in handball. This gap negatively impacts the ability to scientifically assess player development.

Therefore, the researchers aim to address this problem by identifying a model that enhances understanding of the relationship and link between muscular strength and shooting in handball. The ultimate goal is to provide an accurate numerical value that improves player evaluation and develop performance

Objectives

1. To identify muscular strength and the indicator of shooting accuracy in handball.
2. To establish a model for muscular strength and the indicator of shooting accuracy in handball.

Domains of the Study

1.4.1 Human Domain: Players from the Premier Handball League for the 2024–2025 season.

1.4.2 Time Domain: From December 9, 2024, to June 10, 2025.

1.4.3 Place Domain: Training halls of the clubs included in the research sample.

Methodology

The methodology represents the path through which the truth of a phenomenon is uncovered by identifying relationships among its key variables, of which the phenomenon is comprised (Joudat Ezzat, 2009, p. 85). The nature of the research problem determines the appropriate methodology for reaching objective and suitable solutions. Accordingly, the researchers adopted the descriptive approach using correlational analysis, as it aligns with the nature of the study problem.

Community and Sample of the Study

The community of the study consisted of (192) players from the Premier Handball League during the 2024–2025 season. While the sample of the study included (30) randomly selected players, (by lottery), from the clubs of Al-Shorta, Al-Jaish, Al-Hashd Al-Shaabi, and Diyala. An exploratory pilot sample consisted of (6) players. The remaining players were excluded from the sample due to their roles as goalkeepers, injuries, or commitments with the national team's training camp. Table (1) illustrates the distribution sample.

Table (1). Illustrates the distribution sample

No	Clubs	Number of players	Pilot experiment	Main experiment
1	Al-Shorta	16		8
2	Al-Jaish	16		8
3	Al-Hashd Al-Shaabi	16		8
4	Diyala	16	6	6
Total		64		30

Data Collection and Tools of the Study:

The study employed a range of tools and devices to collect data and conduct measurements, including:

- Personal interviews
- Arabic and foreign sources and references
- Test registration form
- Medicine ball (2 kg)
- Four squares (40 cm × 40 cm) placed at the corners of the goal
- Eight handballs (Size 3)
- Stopwatch
- Camera
- Whistle

Field Procedures of the Study

Identification Variables of the study:

Following a comprehensive review of relevant literature and previous studies, the researchers identified the following variables:

- Explosive strength of the arms
- Explosive strength of the legs
- Speed-strength of the arms
- Speed-strength of the legs
- Stationary shooting accuracy

Selection of Research Tests

To measure the identified variables, the following standardized tests were selected:

- **Explosive Strength of the Arms:**

Medicine ball throw for maximum distance using the arms (Athir Al-Lami, 1999, p.49)

- **Explosive Strength of the Legs:**

Vertical jump test – Sargent test (Kamal Al-Din, 2002, p.172)

- **Speed-Strength of the Arms:**

Front support test – arm flexion and extension for 15 seconds (Saad Mohsen, 2014, p.52)

- **Speed-Strength of the Legs:**

Hopping test for maximum distance in 10 seconds (Qasim Hassan, 1994, p.154)

- **Stationary Shooting Accuracy:**

Stationary shooting test (Mays Saddam, 2021, p.70)

Pilot Study

A pilot study was conducted on Thursday, February 6, 2025, at 10:00 AM in the Diyala Club Hall. The aim was to evaluate the suitability of the selected tests for the sample of the study. The pilot experiment involved six handball players from Diyala Club and was carried out with the assistance of the research team.

Scientific Bases

Validity

Content validity was used to assess the validity of the tests. A valid test is defined as one that measures the intended function without substitution or addition of unrelated elements (Abdullah Al-Kindi, 1999, p.154). The tests were presented to the experts and specialists, who confirmed their validity and appropriateness for the sample of the study.

Reliability

Reliability refers to the consistency of test results upon repeated application (Sami Melhem, 2000, p.287). The test-retest method was applied to a sample of four players from the study group. The test was repeated after seven days, and the Pearson correlation coefficient was used to calculate reliability.

The Main Experiment

It was conducted on a sample of (30) elite handball league players. Strength and shooting skill tests were administered in indoor halls of the selected clubs at 4:00 pm from May 4 to May 8, 2024, as follows:

- Sunday: Al-Shorta Club
- Monday: Al-Jaish Club
- Tuesday: Al-Hashd Al-Shaabi Club
- Wednesday: Diyala Club

All logistical preparations were completed by the supporting research team. The data were collected to be statistically processed.

Statistical Means:

Appropriate statistical methods were selected based on the nature and objectives of the study.

Result and Discussion

Presentation of the muscular strength model and the static shooting accuracy index, along with their analysis and discussion."

Table (2). Presents the statistical description of muscular strength and the stationary shooting accuracy index.

Variables	Unit	Arithmetic Mean	Standard Deviation	Skewness Coefficient
Stationary shooting accuracy index	Number	3.82	0.17	0.13
Explosive Strength of the Arms	Distance	10.91	0.28	0.36
Explosive Strength of the Legs	Distance	38.21	1.25	0.75
Speed-strength of the arms	Nunber	16.18	0.57	0.31
Speed-strength of the legs	Distance	11.48	1.01	0.63

Presentation and Analysis of Simulation Results Using the Neural Network System in Terms of Muscular Strength and Stationary Shooting Accuracy Index in Handball:

Simulation Results of the Neural Network System

Table (3). Illustrates the simulation results using the neural network system for the study variables.

Case Processing Summary			
		N	Percent
Sample	Training Sample	8	%26
	Test Sample	16	%53
Total		24	%79

Residuals	6	%20
Overall Total	30	%100

Table (4) shows the total number of attempts, amounting to 30 players, which were divided into two groups: the training group, used for training on the data (inputs and outputs), and the testing group, through which the weights were evaluated, with the presence of hidden layers. The number of individuals in the first group (training group) was 8 players, while the other (testing group) included 16 players. It is also evident that all observations were valid for statistical processing, and no observation was excluded.

Defining a Model for Muscular Strength in the Skill of Stationary Shooting:

Table (4). Presents a Summary of the model for **Stationary Shooting**

Model Summary		
Training	Sum of Squared Errors (SSE)	0.091
	Relative Error	1.130
	Stopping Criterion Used	1 consecutive step (s) with no decrease in error^a
	Training Timing	0:00:00.01
Test	Sum of Squared Errors (SSE)	0.028
	Relative Error	0.897
Dependent Variable: Consistency of Indicator		
a. Error computations are based on the testing sample.		

Table (5). Presents the Parameter Values

Parameter Estimates				
Predictor		Predict		
		Ed		Output Layer
		Hidden Layer 1	H	
Input Layer	(Bias)	H (1:1)	H (1:2)	
	Explosive Strength of the Arms	2.14	0.89	
	Explosive Strength of the Legs	0.48	0.27	
	Speed-strength of the arms	0.51	0.18	
	Speed-strength of the legs	0.27	0.14	
		0.65	0.32	
Hidden Layer 1	(Bias)			3.21
	H (1:1)			0.12
	H (1:2)		0.11	

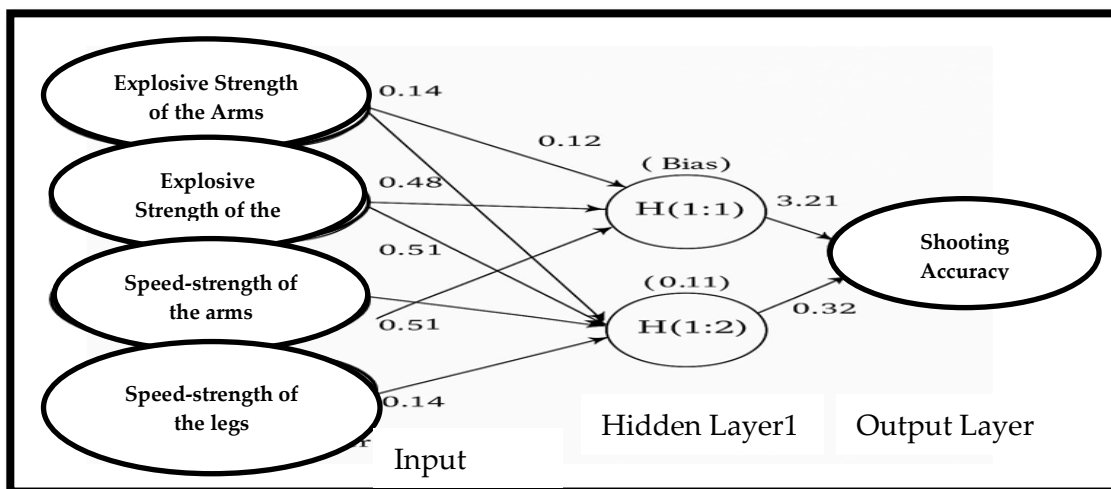


Figure (1) illustrates the network diagram

It is evident from the two tables and the figure above that the values of the numerical weights represent the magnitude of influence each variable carries toward subsequent variables. These weights serve as the numerical expression of the connections illustrated in the diagram, reflecting the relationships and value flows between variables.

Through the network diagram, it becomes clear that the final outcome is the **accuracy index**, as demonstrated by the values shown in Table (5). Furthermore, multiple equations can be formulated for any dependent variable—whether within the hidden layers or for the accuracy indicator itself—based on the incoming pathways from preceding variables, while also accounting for the **Bias** value.

Results Discussion of the Contribution Ratio of Muscular Strength to the Index Shooting Accuracy from a Static Position

The relative importance of the variables and their contribution to shooting skill were found to be significant, particularly in terms of the explosive strength of the arms and legs, as well as the speed-strength of both limbs. These muscular strength components had a clear impact on shooting accuracy from a static position among the sample of the study, through using both limbs, arms and legs, during the shooting phase. Therefore, it is essential for coaches and trainers to focus on developing this attribute. As Qasim Hassan (1995:224) notes, "Training and various tools such as medicine balls and weighted belts have a significant effect on the development of muscular strength. These exercises rely on increasing the speed of muscular contraction, as the goal of preparing muscular strength is to generate force." Muscular strength plays a vital role in static shooting performance, especially when exercises are closely linked to skill execution, which positively reflected on performance.

This is further supported by Risan Khraibet (2002:70), who asserts that "Strength is directly related to the level of skill execution mastery. The higher the skill level, the greater the coordination between muscle fibers and muscles, improving the temporal and dynamic distribution of motor performance. Therefore, an athlete cannot achieve a high level of

strength unless his skill performance is also elevated."The integration of physical and technical abilities is a cornerstone of modern training principles in handball. Moreover, handball performance requires strength in both the legs and arms. This is confirmed by Jamil Qasim Mohammed Al-Badri and Ahmed Khamis Radi Al-Sudani (2012:53) who state that "A handball player needs both speed and strength, especially when transitioning between defensive and offensive situations. That is, while executing rapid movements on the court in various directions and positions, including defense and attack, as well as for determining ball speed, which is directly influenced by player speed." From a technical standpoint, shooting skill is the key to gameplay and the means of achieving victory and playing results. Especially for players who master shooting and are properly trained in it.

As Ali Turki Muslih and Ahmed Youssef Al-Shamkhi (2002:12) emphasize, "Shooting is one of the offensive skills upon which match outcomes depend. Some view shooting as a 'finishing skill,' as it concludes the sequence of technical and tactical actions, along with the accompanying psychological stimulation. The result of the shot represents the final value of all those deliberate measures and decisions."

Conclusion

In light of the statistical analyses of the results presented, interpreted, and discussed, it was concluded that the neural network program proved effective in identifying correlation relationships and determining the relative significance of the study variables. A scientific model was established based on muscular strength and shooting accuracy indicators. The researchers recommend that coaches adopt this model in the training process. They also emphasize the necessity for researchers to utilize modern statistical programs and to conduct further studies on other types of shooting techniques.

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