Journal of Physical Education

Volume 37 – Issue (3) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729

https://jcope.uobaghdad.edu.iq

The Effect of a Training Program Based on Artificial Intelligence Techniques According to Physical Fitness Level Using Motion Sensors (Accelerometer & Gyroscope) on Developing Explosive Power and Passing and Shooting Skills Among Young Basketball Players

Duaa Habib Talab [1]

[1] University of Technology, Faculty of Mechanical Engineering

DOI:

https://doi.org/10.37359/JOPE.V37(3)2025.2322

Article history: Received 20/ May/2025 Accepted 27/ May/2025 Available online 28/ September/2025

Abstract

Basketball training no longer relies solely on coaches' personal experience or traditional on-field repetition. Instead, it has undergone a qualitative shift thanks to the integration of artificial intelligence (AI) technologies, which have become effective tools in analyzing performance and guiding training with precision and objectivity. In light of rapid technological advancements, it is now possible to obtain accurate motion data that surpasses human observational capabilities, enabling the design of individualized training programs tailored to each player's needs. The research problem stems from field observations indicating a decline in the performance level of several young basketball players during matches in the Iraqi league. This decline is attributed to difficulties in maintaining a high level of physical and technical performance throughout the game, especially during extended periods of play or under conditions that require sustained high effort. This leads to a drop in passing accuracy and weaker performance in one-on-one situations.In response to these challenges, the researcher designed an innovative training program based on AI technologies, utilizing performance sensors (Accelerometer & Gyroscope) to assess and analyze each player's physical level and adapt training accordingly.The study adopted an experimental methodology using two groups: an experimental group that underwent the AI-based training program, and a control group that trained using traditional methods. The program lasted six weeks, with two training sessions per week. The results clearly demonstrated the superiority of the experimental group in developing speed endurance, as well as improving performance in essential basketball skills such as passing and shooting. These findings highlight the

[1] University of Technology, Faculty of Mechanical Engineering, doaa.h.talab@uotechnology.edu.iq

Journal of Physical Education

Volume 37 – Issue (3) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

effectiveness of integrating artificial intelligence and motion analysis in enhancing the athletic performance of young basketball players

Keywords: Artificial Intelligence Techniques, Motion Sensors, Accelerometer, Gyroscope, Physical Fitness Level.

Introduction

Basketball is a team sport that requires a high level of physical fitness and precise technical skills, with explosive power, passing, and shooting skills playing a crucial role in a player's on-court performance. Sports training no longer relies solely on coaches' experience and intuition, as it once did. It has become more precise and effective thanks to technological advances and artificial intelligence applications. In the modern digital age, it has become possible to analyze athletic performance with an unprecedented level of accuracy, surpassing traditional assessment capabilities. This has opened up broad horizons for designing training programs aimed at developing each player's individual physical and skill capabilities. Recent years have witnessed a remarkable development in the use of artificial intelligence technologies in sports. In light of rapid technological development, it has become imperative to integrate artificial intelligence technologies into training programs with the aim of improving athletic performance based on players' physical level and enhancing training efficiency through accurate assessment and real-time feedback.Recent studies have indicated that artificial intelligence is capable of analyzing athletic performance with high accuracy, which enhances the efficiency of individual and group training (D, K, M & ,J, 2021, pp. 1152-1170.(Especially in team sports like basketball, physical fitness plays a crucial role in enhancing performance, as it directly impacts players' ability to execute basic skills. Explosive power, passing, and shooting skills are among the key pillars that determine a player's effectiveness on the court. It has become possible to employ smart sensors to accurately analyze motor and physical performance levels, provide real-time data that helps draw a comprehensive picture of the player's needs, and design training modules based on that data. The use of motor performance sensors is Smart bands have become effective and affordable tools for measuring and analyzing physical performance, especially in team sports such as basketball. They are one of the most prominent applications of artificial intelligence in sports, providing accurate data on a player's physical and motor condition, allowing coaches to design individualized training programs based on each player's strengths and weaknesses. These technologies also contribute to the development of specific physical abilities, such as explosive power, which is the foundation for quick and sudden movements such as jumping, lunging, and cutting. Explosive power plays a pivotal role in basketball, particularly in quick movements such as jumping for a shot or rebound, and sprinting towards the ball, in addition to enhancing basic technical skills, most notably passing and shooting. Given this importance, this study sheds light on the impact of an AI-based training program

Journal of Physical Education

Volume 37 – Issue (3) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729

https://jcope.uobaghdad.edu.iq

adapted to the physical level of female players, using performance sensors as an accurate analysis tool, to develop explosive power and improve passing and shooting skills. This approach comes within the framework of the effort to enhance training efficiency and achieve the highest possible returns from training modules, thus contributing to improving the team's overall performance and supporting their path to achieving higher levels of professionalism.

Study problem

Many young female basketball players struggle to maintain a high level of physical and technical performance during a game, especially during long periods of play or in conditions that require high and sustained effort. Explosive power is one of the most important physical requirements affecting the quality of skill performance, particularly in executing accurate passes and effective shooting. However, a decline in this ability leads to decreased passing efficiency, slower responses, and poor performance during one-on-one confrontations. Field observations indicate that relying on traditional training programs that follow a uniform pattern that does not take into account individual differences among players may be insufficient to develop these crucial abilities to the desired extent. This calls for innovative training methods that take into account each player's individual level. With advances in artificial intelligence and sensor technology, modern technological solutions have emerged that enable the accurate analysis of motor and physical performance through sensors such as the accelerometer and gyroscope integrated into smart fitness bands. These devices provide real-time, objective data that can be used to design individual training programs powered by artificial intelligence, aimed at developing explosive power and improving basic skills such as passing and shooting. From this perspective, the problem of the current study arises in the following question:

How effective is an AI-based training program, based on physical fitness analysis using motion sensors (accelerometer & gyroscope), in developing explosive power, passing and shooting skills in young female basketball players?

Research objectives

1-Identifying artificial intelligence techniques according to physical level using the motion sensor (Accelerometer & Gyroscope) and in developing explosive power, passing and shooting skills among young female basketball players.

2-To identify the effect of a training program enhanced with artificial intelligence techniques according to the physical level using the motion sensor (Accelerometer & Gyroscope) in developing explosive power and passing and shooting skills among young female basketball players.

Journal of Physical Education

Volume 37 – Issue (3) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729

https://jcope.uobaghdad.edu.iq

Research hypotheses

1-There are statistically significant differences between the pre- and post-tests of the research sample in developing explosive power, passing and shooting skills among the research sample.

2-There are statistically significant differences between the experimental and control groups in developing explosive power and passing and shooting skills among young female basketball players .In favor of one of the two groups

Research areas

Human field: (14) players from the young women of the Sulaymaniyah Sports Club

Time frame: from 10/11/2024 to 12/4/2025.

Spatial area: Sulaymaniyah.

Research methodology and field procedures.

Research methodology

Given the experimental nature of the research problem, the researcher saw that the experimental approach is the most appropriate for addressing this problem, as it provides the possibility of controlling the basic variables affecting the phenomenon being studied. It is "an attempt to control all the basic factors affecting the dependent variable or variables in the experiment, except for one factor that the researcher controls and measures its effect on the dependent variable or variables) "Abdul Hamid and Kazim, 2001, p. 105.(

Research community and sample

The research sample consisted of (14) players from the Sulaymaniyah Sports Club, who regularly play basketball within the youth category at the Sulaymaniyah Club, and they were chosen in a deliberate random manner. It is worth noting that (randomness in choosing the sample does not mean spontaneity or improvisation, but rather requires accuracy and care in applying the selection methodology) to ensure appropriate and objective representation of the members of the original community) .Alam, 2010, p. 19(They were divided into two groups, experimental and control, as they represent the research community faithfully.

Methods of collecting information, devices and tools

Information collection methods

1-Technical observation and experimentation.

Journal of Physical Education

Volume 37 – Issue (3) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729

https://jcope.uobaghdad.edu.iq

2-Personal interviews.

3-Tests and Measurements

Tools and equipment

measuring tape, whistle, indicators, Basketball number (6), stopwatch, target zone.

Measurement and testing

1- Explosive strength test Vertical jump test (Sargent) Alawi and Radwan, 1994 .

Purpose of the test: To measure the explosive strength of the leg muscles.

Performance Description: The tester stands after immersing his fingers in a special substance (calbork) next to the scoreboard (or a fixed measuring tape). The tester raises his special arm completely to its extension to place a mark for fingers on the board without raising the heels and not raising the shoulder level of the special arm above the shoulder level of the other arm. After that, the arm is lowered, the arms swing together forward and backward with the knees half bent and extended to jump vertically to the maximum possible height and place a new mark with the special arm and along its extension. The distance between the two marks is a result of the strength of the jumping muscles in the vertical direction.

Registration- :Measured in centimeters, the tester is given three attempts and the best one is recorded.

2- Basketball passing test in different situations (Nelson & & Johnson, 1999, p. 143)

Tools: A ball, a wall, and 5 circles drawn on the wall. Each circle is approximately 50 cm in diameter. They are numbered sequentially.(5-1)

Marking Distribution: Markers are placed at various heights, ranging from 1.2 meters to 2 meters above the ground. The purpose of this distribution is to simulate passing the ball in various situations that require varying accuracy and passing power.

Description: The player stands 4.5 meters from the wall and passes the ball directly towards the marks drawn on the wall (in the shape of a target). The player then receives the ball and passes it back.

Score: The number of successful passes is calculated in a specified period of time (e.g., 30 seconds).

3-Peaceful scoring test (Hammoudat and Jassim, 2005, p. 234)

Journal of Physical Education

Volume 37 – Issue (3) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729

https://jcope.uobaghdad.edu.iq

Purpose of the test: To measure the accuracy of ladder scoring.

Equipment needed: basketball court, basketball goal, whistle to start.

Number of attempts: Each player is given (10) attempts.

Points calculation: The player is awarded one point for each successful scoring event, where the highest points a player can collect are (10) points.

4-Scoring test by jumping from under the basket (Jawad, 2004, p. 180)

Purpose of the test: To measure accuracy in scoring from under the basket.

Equipment needed: basketballs, basketball goal, stopwatch.

Number of attempts: Each player is given two attempts.

Calculating points: One point is calculated for each ball that enters the basket. The total points obtained by the player in each attempt are calculated. Points are calculated for the player for the best attempt within (30) seconds.

Field research procedures

Pre-tests

The researcher conducted pre-tests for the research sample of female basketball players from the Sulaymaniyah Sports Club .On Sunday, November 10, 2024, the physical and skill capabilities measurement tests were conducted on the Sulaymaniyah Club field, at 3:30 PM. These tests aimed to collect primary data related to the study variables. In order to verify the homogeneity and equivalence of the sample members in these variables, ensuring that all participants start from a similar level when implementing the training program, the researcher calculated the statistical value (T) to verify the absence of statistically significant differences between the sample members in the pre-measurement stage

Sample homogeneity

Table 1. show Sample homogeneity

variable	Unit of measurement	The middle	The mediator	deviation	skewness
explosive power	right	34.50	34.5	1.160	0.517
Handling	number	15.571	16	1.01	0.544

Journal of Physical Education

Volume 37 – Issue (3) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729

https://jcope.uobaghdad.edu.iq

Peaceful scoring	a point	6.928	7	0.615	0.024
scoring from below basket	a point	9.072	9	0.616	0.025

Mutualism between two groups

Table 2. It shows the equivalence between the two research groups, the experimental and the control.

variable	control group		experimental group		value (t)	Error level
	Mean	SD	Mean	SD		
explosive power	34.85	1.345	34.142	0.899	1.168	0.266
Handling	15.142	0.899	16.00	1.00	1.686	0.118
Peaceful scoring	7.00	0.577	6.857	0.690	0.420	0.682
scoring from under the basket	9.142	0.690	9.00	0.577	0.422	0.679

*Moral at error level (0.05)≥with a degree of freedom of.(12)

Main experiment

An AI-enhanced training program has been developed to develop explosive power, passing and shooting skills in young female basketball players .Using ChatGPT technology, the program's goal is to use artificial intelligence technologies to analyze the physical and skill capabilities of young female players, then customize individual training sessions tailored to each player's needs based on accurate data. Data is collected using advanced performance sensors and motion tracking devices (accelerometer & gyroscope), then processed by artificial intelligence technologies to provide personalized training recommendations.

Application period: The training program begins on Wednesday, November 13, 2024, and continues until Wednesday, January 8, 2025.

Artificial intelligence is used to design innovative training strategies aimed at preparing female athletes to compete.

Journal of Physical Education

Volume 37 – Issue (3) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729

https://jcope.uobaghdad.edu.iq

Players are classified into three levels (high, medium and weak) using the motion sensor.

The program extends over 8 weeks.

The program includes two training units per week, on Sundays and Wednesdays.

Focus on developing explosive power: The program includes targeted exercises to improve explosive power, which is the basic physical ability in basketball that greatly affects skill performance.

Improving basic skills: Specific exercises include improving ball control, passing, dribbling, and shooting skills. Each drill is designed to reflect the players' physical and technical abilities.

Gradual adaptation: The program features a gradual adjustment mechanism based on the improvement of each player's physical abilities, ensuring maximum benefit from the exercises.

Exercises are included that rely on periods of intense effort followed by controlled rest periods based on data generated by the physical response.

Players' stress is analyzed and training loads are carefully adjusted to reduce the possibility of injury.

The system uses artificial intelligence to analyze performance and provide weekly updates on the training program based on progress.

The training load is distributed according to the players ’levels using an artificial intelligence program.

Total number of training units: 16 training units over the course of the program.

The control group trains according to the trainer's curriculum.

Post-tests

The researcher conducted the post-tests on the players on Sunday, January 12, 2025. She conducted the tests for explosive power and the skills of passing and shooting at the Sulaymaniyah Sports Club stadium at (thirty past three). The researcher conducted the post-tests with the same procedures as the pre-tests on the team’s players:

Statistical methods

Journal of Physical Education

Volume 37 – Issue (3) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729

https://jcope.uobaghdad.edu.iq

The data were processed to achieve the research objectives and hypotheses using statistical methods. The researcher used the SPSS statistical package and the following statistical laws:

1-Arithmetic mean.

2-The mediator.

3-Standard deviation.

4-Coefficient of skewness.

5-T-test for unrelated samples

6-T-test for correlated samples

Result

Table 3. Shows the arithmetic mean and value t calculated in the pre- and post-tests of the control group

Test name	Pre-test		Post-test		Mean Deference	T value	P-value
	Mean	SD	Mean	SD			
explosive power	34.85	1.345	40.0	1.00	5.142	8.18	0.000
Handling	15.142	0.899	16.857	0.690	1.714	9.292	0.017
Peaceful scoring	7.00	0.577	7.857	0.377	0.857	6.00	0.001
scoring from below basket	9.142	0.690	10.143	0.899	1.00	4.583	0.004

*Significant at 6 degrees of freedom and significance level(0.05) ≥

Table 4. Shows the arithmetic mean and value) t (calculated in the pre- and post-tests of the control group

Test name	Pre-test		Post-test		Mean Deference	T value	P-value
	Mean	SD	Mean	SD			
explosive power	34.142	0.899	42.571	0.975	8.428	14.75	0.000

Journal of Physical Education
Volume 37 – Issue (3) – 2025 Open Access
P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

Handling	16.00	1.00	18.0	0.577	2.00	9.165	0.000
Peaceful scoring	6.857	0.690	8.851	0.899	2.00	6.481	0.001
scoring from below basket	9.00	0.577	11.571	0.786	2.571	8.647	0.000

*Significant at 6 degrees of freedom and significance level(0.05) ≥

Table 5. Shows the differences between the experimental and control research groups.

variable	control group		experimental group		T value	P-value
	Mean	SD	Mean	SD		
explosive power	40.0	1.00	42.571	0.975	4.869	0.000
Handling	16.857	0.690	18.0	0.577	3.361	0.006
Peaceful scoring	7.857	0.377	8.851	0.899	2.711	0.019
scoring from under the basket	10.143	0.899	11.571	0.786	3.168	0.008

*Moral at error level (0.05)≥with a degree of freedom of.(12)

Discussing

The results of the study showed that there were statistically significant differences between the experimental group and the control group in all studied physical and skill variables (explosive power, passing, layup, and under-the-basket scoring), in favor of the experimental group, as the experimental group showed a clear improvement in all studied variables compared to the control group. This improvement is attributed to the integration of modern technologies and advanced training methods, which indicates the effectiveness of the training program based on artificial intelligence techniques and the use of motion sensors. Explosive power: The players of the experimental group achieved a significant improvement in explosive power (42.571) compared to the control group (40.0), with a (t) value of (4.869) and a significant significance at the (0.000) level. This improvement is attributed to the precise ability of the motion sensors to provide immediate and accurate feedback on motor performance, and the precision of the training program in designing an individual training load appropriate for each player, based on the data provided by the performance sensors. This allows the training to be adapted to each player's physical condition, thus improving its ability

Journal of Physical Education

Volume 37 – Issue (3) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729
https://jcope.uobaghdad.edu.iq

to maintain explosive power, which helps players and coaches modify exercises and improve the quality of movements during training. This is consistent with (Chollet, 2017) (that artificial intelligence techniques contribute to designing individual training units based on the physical level of each player, which increases the efficiency of physical development) (Chollet, 2017, p. 154) and this was reinforced by (Baca et al., 2020) by saying (that the use of modern techniques in training programs is an important factor in achieving excellence) (Baca, Dabnichki, Heller & ,Kornfeind, 2020, p. 89). As for the skill of handling (passing), the results showed that the experimental group recorded a higher average (18.0) compared to (16.857) for the control group, and the value (t) (3.361) was significant (0.006). This indicates that the use of artificial intelligence with motion tracking devices helped improve motor precision and neuromuscular coordination during handling skills. Feedback plays a key role in correcting motor errors as they occur, as feedback is important in accelerating the learning process, as stated by Nizar Al-Talib and Kamel Al-Wais" :A person who knows their progress and success will progress faster than someone who trains without this knowledge ".(Al-Talib and Al-Wais, 2002, p. 124) In ladder scoring, the experimental group scored an average of 8.851, compared to 7.857 for the control group, with a t-value of 2.711 at a significance level of 0.019. This confirms that training using motion sensors contributed to improving balance, motor timing, and spatial awareness during ladder scoring. Zhang et al., 2021, also confirms this. (Artificial intelligence techniques are capable of analyzing fine motor patterns during jumping and shooting, which supports the development of skill performance) (Zhang & all, 2021). The results of scoring from under the basket showed that the experimental group outperformed the control group with an average of (11.571) compared to (10.143), and the (t) value reached (3.168) at a significance of (0.008), indicating that the program helped players improve movement timing, shooting angle, and appropriate force to reach the goal. Here, (Pueo et al., 2017) shows that motion sensors can record acceleration and rotation and identify fine motor errors around the basket (Pueo & al., 2017, pp. 218-227). These results indicate that the use of artificial intelligence with motion sensors is not limited to just collecting data, but rather contributes to improving the quality of performance through "reinforced learning and precise individual training that suits each player's physical and skill characteristics. The continuous interaction between the players and the system is also important ".Smart is a psychological stimulant that increases concentration.

Conclusions and recommendations

Conclusions

1-The adoption of artificial intelligence techniques in sports training works to develop the explosive power of young female basketball players.

Journal of Physical Education

Volume 37 – Issue (3) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729

https://jcope.uobaghdad.edu.iq

2-The adoption of artificial intelligence techniques in sports training works to develop the handling skills of young female basketball players.

3-The adoption of artificial intelligence techniques in sports training works to develop the skill of peaceful shooting among young female basketball players.

4-The adoption of artificial intelligence techniques in sports training works to improve the jump shooting skill of young female basketball players.

5-These results underscore the importance of integrating AI technologies into sports training, as sensors provided accurate analysis that helped improve physical and skill performance.

Recommendations

1- Promoting the use of smart sensing technologies to accurately analyze motor and skill performance, contributing to the development of detailed databases that help coaches design targeted and effective training programs tailored to each player's needs.

2-Leveraging artificial intelligence technologies within training modules to dynamically adjust training loads and provide training plans that address individual differences, thus maximizing performance efficiency and improving individual training outcomes.

3-Encourage future comparative research comparing the effectiveness of AI-enhanced training with traditional training methods, to measure the impact of technology on developing the physical and skill performance of young female basketball players.

4-Developing smart training platforms and applications based on artificial intelligence that provide immediate feedback and real-time performance analysis, enhancing self-learning among female athletes and supporting continuous and accurate skill improvement.

Appendix

Sample training program exercises designed using artificial intelligence techniques

Proposed training unit to develop explosive power, passing and shooting skills

Training unit duration: 60 minutes Number of units per week: 2 units

Objective: To develop explosive power and basic skills (passing - shooting)

1-Warm-up (10 minutes) – for all levels

General Exercises (3 minutes): Light jogging + arm rotation + trunk rotation

Journal of Physical Education

Volume 37 – Issue (3) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729

https://jcope.uobaghdad.edu.iq

Dynamic warm-up (5 minutes): Foot speed drills, lateral jumps

Sensor-guided exercises (2 minutes): Small acceleration movements with motion analysis to condition the target muscles.

2- Main exercise: Developing explosive power (20 minutes)

Exercise: Repeated vertical jumps with rubber resistance

Level	Intensity (resistance/speed)	repetition	Rest between rounds
High	High	10 × 4	30seconds
average	Medium	10 × 5	40seconds
weak	low	10 × 6	40seconds

- Monitored via sensors, and direct feedback provided.

3- Skill Exercise 1: Fast, Accurate Passing (15 minutes)

Exercise: Passing from the movement within the squares

Level	Intensity (resistance/speed)	repetition	distance between colleagues	Rest between rounds
High	High	12 × 2	5meters	30seconds
average	Medium	12 × 3	4meters	40seconds
weak	low	12 × 4	3meters	40seconds

- Reaction time, number of accurate passes, and pass force are calculated via sensors.

4- Skills Exercise 2: Shooting under pressure (10 minutes)

Exercise: Shooting from the move after dribbling

Journal of Physical Education

Volume 37 – Issue (3) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729

https://jcope.uobaghdad.edu.iq

Level	Intensity (resistance/speed)	repetition	Pressure type	Rest between rounds
High	High	6attempts x 2 rounds	mobile defender	30seconds
average	Medium	5attempts x 2 rounds	Fixed defender	40seconds
weak	low	4attempts x 2 rounds	No defender	40seconds

5- Cool down (5 minutes)

Stretching, stretching, and deep breathing exercises

Review quick performance data via the sensor's smart app.

Technical notes

AI can be used at the end of the module to provide individual player reports and analytical reports to the coach.

Workouts change weekly as the player progresses based on data analysis.

Journal of Physical Education

Volume 37 – Issue (3) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729

https://jcope.uobaghdad.edu.iq

References

Abdul Hamid, J & ,.Kazim, A. Kh.(2001) .Research Methods in Education and Psychology, 8th ed.Cairo: Dar Al Nahda.

Alam, S. A.(2010) .Inferential statistical methods in the analysis of psychological, educational and social research (barometric and non-parametric).Cairo: Arab Thought House.

Alawi, M. H & ,.Radwan, M. N.(1994) .Motor performance tests, 3rd ed.Cairo: Arab Thought House.

Al-Talib, N & ,.Lewis, K-.(2002) .Sports Psychology 3rd ed.Baghdad: Dar Al-Kutub for Printing.

Baca, A., Dabnichki, P., Heller, M., & Kornfeind. (2020).Ubiquitous computing in sports: A review and analysis. Journal of Sports Sciences.

Chollet, D.(2017) .Performance analysis in team sports .N.Y city: Routledge.

Hamoudat, F. Y & ,.Jassim, M. A.(2005) .Basketball, 4th edition.Mosul: Dar Al-Kutub for Printing and Publishing.

Jawad Kadhim, M., & Salman Ahmed, W. (2016). Evaluating Training Program Using Physiological and Biochemical, and Physical Indicators On National Artistic Gymnastics League For Men. *Journal of Physical Education*, *28*(3), 116-129.

Jawad, A. S.(2004) .Testing, measurement and statistics in the field of sports.University of Al-Qadisiyah.

Khedir, S. Q. (2018). *The Legal Protection and Regulation of Sponsorship Rights in English Football* (Doctoral dissertation, University of Leeds).

Nelson, J., & & Johnson, B. (1999). Practical Measurements for Evaluation in Physical Education. Minneapolis, Minnesota: Burgess Publishing Company.

Owl, B., & al, e. (2017). l Application of inertial measurement units (IMUs) in sports performance analysis. . Journal of Human Sport and Exercise.

R, B. (2020). Sports Biomechanics. Reducing Injury and Improving Performance. Routledge.

Zhang, Y., & all, e. (2021).l Artificial intelligence-based monitoring and assessment system for basketball training. . IEEE Access.