ISSN Print: 2664-7559
ISSN Online: 2664-7567
Impact Factor (RJIF): 8.19
IJSHPE 2026; 8(1): 19-24
www.physicaleducationjournal.in
Received: 20-11-2025
Accepted: 23-12-2025

Ali Mahmoud Jabar
Al-Muthanna University, College of College of Physical Education and Sports Sciences, Iraq

Corresponding Author:
Ali Mahmoud Jabar
Al-Muthanna University, College of College of Physical Education and Sports Sciences, Iraq

The effect of different types of stimulation as a mechanism to enhance muscle activity after warming up on the anaerobic capacity of players Basketball in Samawah

Ali Mahmoud Jabar

DOI: https://www.doi.org/10.33545/26647559.2026.v8.i1a.313

Abstract
The current research aims to identify the effect of three different types of stimulation by examining the difference between the pre-test results, which are conducted without any type of stimulation, and after a period, using the same warm-up for the three groups, but each group received a type of additional stimulation to determine the difference between the pre-measurement and the post-measurement (after the treatments), as well as to identify which of these types achieved the highest physiological response and anaerobic performance. The sample included 15 basketball players who were randomly divided into three equal groups, with 5 players in each group. The first group was subjected to weight training as a form of motivation after warming up, the second group used rubber bands for motivation, and the third group used EMS for motivation, all before performing the anaerobic capacity test. The researcher statistically inferred using a one-way experimental design, where the types of stimulation were considered the three independent variables and anaerobic capacity the dependent (affected) variable. To analyze the values, the researcher used one-way ANOVA, and to identify the comparisons, the Bonferroni test was relied upon to determine the preference. The researcher reached several results, showing differences between the pre-test and post-test for all types of stimulation. As for Bonferroni, the first group that used weights for stimulation enhancement was followed by the second group using rubber bands, and then the third group using electrical stimulation. In addition, the results of the effect size (Cohen's d) were very large in all groups during the pre-test and post-test measurement period.

Keywords: Samawah, basketball, stimulation, post-test measurement, anaerobic capacity test

Introduction

Introduction to the research and its importance

Anaerobic capacity (lower limbs) is considered one of the most important physical variables for all sports in general and phosphagenic and lactic events in particular, as it has a strong correlation with achieving athletic performance and excellence. Its integration is especially crucial for basketball players, and it also helps prevent injuries. Many athletes and trainers strive to develop and enhance it among athletes using various patterns, methods, and diverse training aids. Attention is also given to warm-up ratios and their development, as they are the cornerstone for starting any physical activity. The use of motivational tools to stimulate slow oxidative fibers, which are first activated, and then fast glycolytic fibers, which are lighter in color, combining the characteristics of both slow and fast fibers, and fast glycolytic fibers, which are white and anaerobic, lacking myoglobin. The fast fibers, which are divided into two types: the first type is glycolytic, lighter in color than red, combining the characteristics of both slow and fast fibers, and the second type is glycolytic, white in color, called fast anaerobic, lacking myoglobin All these complex structures need enhancement methods to stimulate them after performing warm-up exercises, meaning additional intensity to utilize them optimally, such as using free weights, jump benches, medium-resistance rubber bands, and EMS electrical stimulation, which act as complementary factors to reach more motor units. Additionally, they protect against sudden movements and stresses that fall on the muscles and joints, which could lead to injuries if the warm-up aspect is neglected. Despite the availability of numerous studies on the warming-up aspect, this study addressed the stimulation mechanism for muscle activation using complementary means. Basketball, in particular, requires continuous use of anaerobic capacity during play (vertical jumping).

Based on this, the study was designed to investigate the effect of each type of stimulation as a mechanism for muscle activation of the lower limbs using weights (dumbbell jumps), rubber bands (repeated upward jumps), and electrical stimulation (EMS). He works by connecting sensors to all thigh muscles. After dividing the community into three equal samples and measuring muscular strength after warm-up and after warm-up and activation, with the aim of understanding the differences between pre- and post-measurements, their preferences, and the extent of the impact they left. Then, a set of recommendations were proposed based on the study's results in a scientific and objective manner

The importance of the current study from a scientific perspective lies in the attempt to reach the truth by identifying the difference in the anaerobic power variable (vertical jump test) for basketball players after the unified warm-up for the three groups (pre-measurement) and after the warm-up and the three treatments for each group: weight training, rubber bands, and EMS. Post-test) from a practical standpoint supports coaches and those in charge of training courses with scientific data that contribute to selecting the best and most suitable warm-up and muscle stimulation for basketball players.

As for the required importance later, it helps in conducting a more comprehensive study with larger samples, age groups, and other activities that require anaerobic capacity or any variable that aligns with motivational means after warming up

Research Problem

The researcher defined the research problem with the following questions, which stated:

- Is there an effect of the weight-based motivational tool after warming up on the anaerobic capacity of the players?
- Is there an effect of the motivational method using rubber bands after warming up? On the anaerobic capacity of the players.
- Is there an effect of the motivational method with (EMS) after warming up? On the anaerobic capacity of the players.
- Are there differences in anaerobic capacity between the three groups in the pre-test and post-test?.
- Which of the motivational methods is the most effective?

Research Objectives

The research aims to identify:

- The effect of using weights as a motivational tool on the anaerobic capacity of players.
- The effect of using resistance bands as a motivational tool on the anaerobic capacity of players.
- The effect of the stimulation method using EMS on the anaerobic capacity of players.
- Comparison of differences in anaerobic capacity between the pre-test and post-test (only warm-up vs. warm-up with a motivational tool) for the three groups.
- Identifying the superiority in anaerobic capacity among the three groups.
- Analyzing the interaction between (weight training, resistance bands, EMS) after warming up and the measurement duration at the anaerobic capacity level.

Research Hypotheses

There is an effect of the motivation method (weights, resistance bands, EMS) on the anaerobic capacity of the players. At a significance level of 0.05.

- There is a preference for the weight training method over the group that used resistance bands and EMS in the anaerobic capacity of the players at a significance level of 0.05.
- There is a preference for the group that used the stimulation method over the group that used EMS in the anaerobic capacity of the players at a significance level of 0.05.
- There is an interaction effect between the motivation methods and the measurement duration, and an interaction effect between their levels on the anaerobic capacity of the players. At a significance level of 0.05

Research Areas

- First, the human domain
- Secondly, the temporal domain
- Thirdly, the spatial domain

Terms Used in the Research

First: Electrical Muscle Stimulation (EMS): It is a technique that relies on sending low-frequency electrical pulses to the muscles thru electrodes placed on the skin, with the aim of stimulating muscle contractions similarly to natural muscle movements. It has a range of applications in the field of improving physical performance, stimulating fat burning, rehabilitation, and sports training.

Research methodology and field procedures:

The researcher used the experimental method because it aligns with the nature of the current study in terms of the problem and objectives.

The Experimental Design

In light of the latest scientific directives regarding the formulation of scientific research in the field of sports, it is essential to determine the appropriate and precise methodology that allows for its application. The experimental method is the most prominent one that examines the impact of independent variables during the measurement period and between groups. Therefore, the researcher chose the factorial design the factorial ANOVA design (GLM4), specifically the one-way ANOVA (single-factorial experiment) as illustrated in Diagram (1) which shows this design.

Fig 1: Experimental design

The group	Number of people	Pre-test	Intervention	Post-measurement
First	8	Anaerobic capacity	Weight training	Anaerobic capacity
Second	8	Anaerobic capacity	Resistance with elastic bands	Anaerobic capacity
Third	8	Anaerobic capacity	EMS stimulation	Anaerobic capacity

The research community includes players from the basketball school in Al-Muthanna Governorate, with a sample size of 24. This sample was divided into three groups using simple random sampling, with each group consisting of 8 players.

Each group underwent a uniform body-weight warm-up, followed by the Sergeant test to measure anaerobic capacity, and then another warm-up, after which each group received stimulation. As follows.

- The first group is a warm-up accompanied by stimulation using weights.
- The second group warms up accompanied by stimulation using resistance bands.
- The third group warms up with stimulation using electrical muscle stimulation (EMS).

As for the survey sample, 6 players were selected, with 2 players from each group, using the stratified random sampling method, where each player represented the general characteristics of the research population in terms of height, training age, and weight. The level of anaerobic capacity, as shown in Figure 2, was ensured for the preliminary assessment.

Fig 2: Survey Sample

Test group	No sample	عدد الأفراد
Firs	8	2
Second	8	2
Third	8	2
Total	24	6

33 Research Tools

The researcher used the Sergeant Vertical Jump Test to measure.

- The purpose of the test is to measure the anaerobic capacity of the lower muscles by determining the highest vertical height that can be reached.
- The procedure: The player stands next to a wall and stretches their arm upwards to determine the starting point of the measurement. He is asked to jump as high as he can and mark the highest point on the wall.
- The difference between the two points is calculated. Starting point + designated jump point = vertical anaerobic power.
- Note: Each participant was given three attempts, and the best one was taken. The greater the difference between the two points, the better the achievement in anaerobic capacity.

The Pilot Study: Every researcher aims to ensure the validity of the test and the compatibility of the research sample with the test. An exploratory trial is necessary, the purpose of which is to identify the positives and negatives that the researcher will face during the main experiment. This trial reveals the test statement, the clarity of the measurement tool, and the extent to which the procedures are suitable before applying the details of the main study, in addition to the effectiveness of the guidelines and instructions provided to the sample members. And controlling the measurement efficiency, adjusting the procedures in terms of the specified duration and arrangement of tools, identifying potential errors during the main application, and ensuring that the improvement in results is due to the proposed intervention and not to other procedural factors. The pilot experiment was conducted on (25/9/2025) on a sample consisting of 6 players at 4 PM. Where the results were good and encouraging for conducting the main experiment.

The scientific foundations of the test

- **Validity:** The researcher used the Looch method to calculate validity by presenting the test to four judges to determine their opinion on the test's suitability for measuring the phenomenon (research variable) of anaerobic capacity. The agreement rate among the experts was 100%, with a test score of 9.901, which is greater than 0.61, indicating the test's validity. As shown in Table (3) which illustrates this.
- **Reliability:** To ensure the reliability of the tool used to measure the variable and to determine the stability of the test, the researcher adopted the test-retest reliability method. The test is applied to the same sample twice with an appropriate time interval, and then the correlation coefficient is calculated to verify the stability of performance over the specified time period of one week, provided that the retest is conducted under the same conditions and procedures as the first test. As shown in Table 3 which illustrates this.
- **The objectivity of the test:** The researcher aimed for the test's objectivity by finding agreement between the results of the two judges who recorded the test results. The significance of the correlation was verified using the correlation coefficient (F), where the correlation coefficient value was found to be less than 0.05, indicating the objectivity of the test As in Table 3.

Table 3: Indicating the objectivity of the test as

The scientific foundations of the test	Statistical significance	Degree of freedom	F cal.	Value of the correlation coefficient
Validity	0.00			0.932
Stability	0.000	_	_	(Consistency)
Objectivity	0.000	8	19.861	0.875

Main study procedures

After completing the pilot study and validating the test used to measure the research variable anaerobic capacity, it was found that the test possesses high scientific value. The researcher conducted the main experiment.

First, The sample was divided into three groups, and a uniform warm-up was applied to them, starting with walking and light jogging for two minutes, followed by physical exercises such as arm rotations during jogging, trunk twists to the sides, hip strikes, knee raises to the front, and lateral jumps with both feet. Then, two sprints to the middle of the field and comprehensive stretching exercises were performed, followed by the vertical jump test (Sargent) to measure anaerobic capacity on 27/9/2025, which corresponds to Saturday.

Secondly, in the second phase of the test, the same warm-up conducted on the three groups in the first phase was applied after three days to ensure complete recovery, on 30/9/2025, which corresponds to Tuesday. Then, for the first group, stimulation was performed immediately after the warm-up using a free weight (dumbbell jump) at an intensity of 30% of each player's maximum intensity, repeated 12 times

(jumps), followed by the vertical jump Sergeant test. As for the second group, they also performed the same warm-up, followed by stretching a medium-intensity blue rubber band (Tube Bands) used for advanced general training, especially leg exercises, which was tied to the player's thigh, followed by 12 jumps Then, the vertical jump Sergeant test was performed. The second group also did the same warm-up, followed by stretching a medium-strength blue rubber band (Tube Bands), which is used for advanced general training, especially leg exercises. It was tied to the player's thigh, and then 12 jumps were performed, after which the anaerobic capacity test was applied immediately. As for the third group, they also did the same warm-up, followed immediately by the application of electrodes using the EMS (Electrical Muscle Stimulation) device on all the hamstring and quadriceps muscles. Where the electrodes were placed on the anterior thigh muscle, the first one was at the midpoint of the thigh near the muscle origin, and the second electrode was on the muscle belly above the knee approximately. For the posterior thigh, the first electrode was placed at the muscle origin below the semimembranosus muscle, and the second electrode was on the back part of the thigh muscle. As for the calf muscle (gastrocnemius), the first electrode was placed below the knee joint at the muscle origin, and the second electrode was at the midpoint of the muscle belly. As for the tibialis anterior muscle, the first electrode is placed above the front muscle near the shinbone, and the second electrode is placed in the middle of the front shin. Taking care not to place the electrodes directly on the joint (for 2 minutes at an electrical frequency of 20 Hz, which is suitable for stimulation), and then performing the anaerobic capacity test as well. Then record the results for each group member.

Statistical methods, the SPSS statistical package was used

- The arithmetic mean
- Standard error
- Standard deviation
- Loosh test
- Correlation coefficient
- One-way ANOVA.

Presentation, analysis, and interpretation of the results

This chapter of the research aims to present and analyze the results by relying on the one-way ANOVA factorial design to demonstrate the differences between the three research groups in anaerobic capacity.

Table 4: Shows the values of the arithmetic means and standard deviations for the anaerobic capacity variable for the three research groups before.

Groups	No of sample	Mean	St. deviation
First	8	43.125	0.835
Second	8	43.00	0.756
Third	8	43.00	0.926

Thru Table 4, it is clear that the three research groups started close in the arithmetic mean (43.125)., 43, 43) this indicates that there is an initial equivalence with standard deviations of (0.835, 0.756, 0.926) respectively

As for Table 5, which represents the arithmetic means after the intervention (after the stimulation), it increased to 5.57 for the group, which is higher than the second and third groups. The second group also showed an increase with an arithmetic mean of 50.25, which is higher than the third group, which also increased from the pre-test, reaching 48.25, showing the least improvement among the groups. As for the standard deviation (0.707, 0.717, 0.926), this indicates that the values are close within each group, meaning the internal variation is low.

Table 5: The values of the arithmetic means and standard deviations for the anaerobic power variable of the three research groups after the two periods

Groups	No of sample	Mean	St. deviation
First	8	55.750	0.707
Second	8	50.250	0.717
Third	8	48.000	0.926

Table 6: Levene's test value and significance level

Levene value	Degree of freedom		Significance
0.42	21	2	0.66

Thru Table 6, it is evident that the p-value is greater than 0.05, reaching 0.66. This indicates that there is no difference in variances between the groups, thus fulfilling the homogeneity condition, which is one of the requirements for the proper use of ANOVA.

Table 7: One-way ANOVA for independent effects

S.O.V	Sum of squares	Degree of freedom	Mean square	F cal.	Significance
With groups	254.33	2	127.423	205.423	0.001
Inter groups	13.000	21	0.619		
Total	267.33	23	-		

From what is presented in Table 7, it is clear that there is an effect between the pre-test and post-test measurements, as the f-value reached 205.24 under a significance level of p 0.001. This indicates that there are significant differences between the three groups in the duration of the measurement (pre-test and post-test), meaning there is a significant result for the studied attribute. As for the variance between the groups in the sum of squares (254.33), this represents the largest part of the total variation, indicating a strong interaction effect. As for the variance within the groups in the mean squares, it was 0.619, which means there is a difference within each group compared to the other groups. The research attributes this change in anaerobic capacity, specifically the improvement compared to the pre- and post-measurement periods, to the three treatments applied to the research groups, which stimulated all types of muscle fibers. This is supported by a study that shows the role of warming up in increasing the rate of nerve impulse firing and improving the recruitment threshold for high-threshold muscle groups, indicating all types of fibers, especially the fast white type III. And also, the stimulation used in the study led to an increase in the temperature of the targeted muscles, which reflected on the aerobic capacity, as indicated in the study that mentions that raising the muscle temperature affects the rate of force generation and the acceleration of muscle contraction. Additionally, warming up prepares the cardiovascular and respiratory systems by increasing heart rate and expanding blood flow and lungs, ensuring that oxygen and fuel reach the working muscles before performance begins. It reduces the risk of injury, ischemia, or sudden muscle injury at the start of intense movement. This can only be achieved with the presence of motivational means and methods after performing the warm-up.

Table 8: Results of the Turkey HSD test for comparing the strategies

Comparison between strategies	The difference between mean	Significance	Lowest value of trust	highest value of trust	Note
Group1-group2	5.50	0.001	4.20	6.80	Statistically significant difference For group1
Group1-group3	7.75	0.001	6.45	9.05	Statistically significant difference For group1
Group2-group3	2.25	0.015	0.95	3.55	Statistically significant difference For group2

Table 8 presents the comparison of levels and the difference between means. At the beginning of the table, the comparison between the first and second levels is noted, which refers to the group that used the weight method for stimulation after warming up and the group that used the rubber band method for stimulation. The difference between the two means appears to be (5.50), indicating a significant difference since the significance level is less than 0.05, reaching 0.001. This indicates the superiority of the first group. As for the comparison between the first and third groups, which used the EMS stimulation method after warming up, the difference between the two means was (7.75) with a significance level of 0.001. And it is less than the error level of 0.05, which indicates the superiority of the first group. As for the difference between the second and third groups, it was 2.25, with a mean difference at a significance level of 0.015, which is less than the error level, indicating the superiority of the second group. All comparisons were statistically significant, as the confidence intervals were on the positive side. This indicates that there is no need to present the subgroups because the differences between each pair of groups are clear. From this, we conclude that the first group is the best, followed by the second, and then the third.

Table 9: Results of the (COHEN'S D) Effect Size Test

Comparison between strategies	The difference between mean	Standard deviation	Effect (COHEN'S D)	Note
Group1-group2	5.50	0.806	6.81	Very high
Group1-group3	7.75	0.816	9.622	Very high

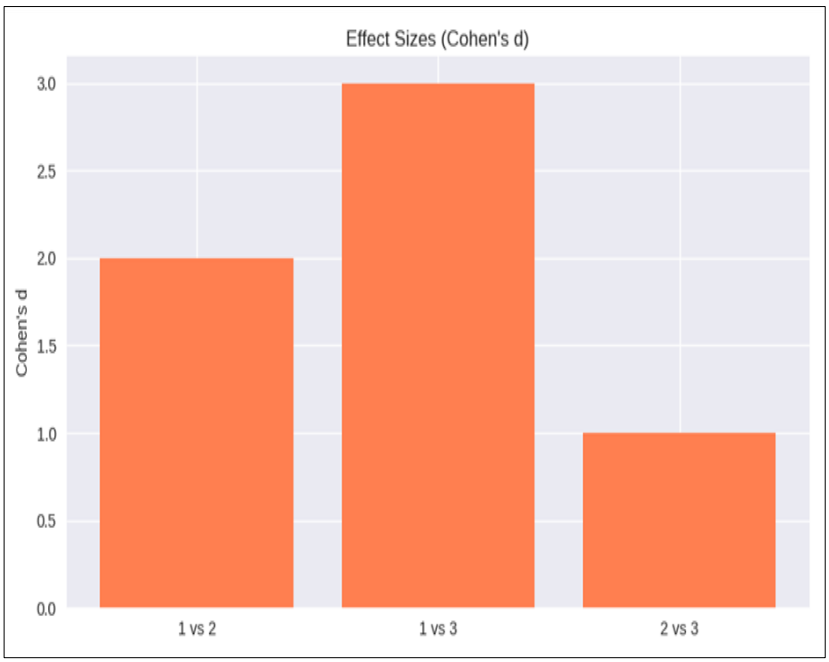

Fig 1: Illustrates the results of the effect size among the three treatments

When studying Table 9, which includes the results of the effect size for the three treatments used in the research, it was shown that the differences are not only statistically significant but also scientifically significant, as the effect size value reached the maximum effect size of 0.8. This indicates that the treatments (weight lifting, rubber bands, EMS) were all effective and influenced the anaerobic capacity of the players. The effect size between the first and second treatments was 6.81, between the first and third was 9.622, and between the second and third was 2.529. From these results, it is clear that the first treatment method (weight lifting) had the greatest effect on the anaerobic capacity variable, while the second group treated with rubber bands and the third with electrical stimulation also had significant effects, but they were close to each other and each led to different results. They both had a significant impact, but they were close to each other, and each led to different results.

Conclusions, recommendations and suggestions

Conclusions

- In light of the results of the sample, which consisted of 24 players and were statistically analyzed using one-way ANOVA, the researcher concluded the following:
- He observed that using an experiment for all influences at once overcomes all obstacles, unlike repeating a simple experiment for each influence separately, which reduces the effort exerted.
- The superiority of all treatments over the measurement duration indicates that the studied muscle stimulation methods after the warm-up have the potential to enhance

anaerobic capacity (vertical jump) but to varying degrees.

- The results of the first treatment group, which used weight stimulation (dumbbell jumps), showed a clear superiority in the vertical jump test (anaerobic capacity), indicating the effectiveness of this motivational method after warm-up in recruiting both red and white muscle fibers of various types. And it is higher than the second and third treatment groups.
- As for the second treatment group that used rubber band stimulation, it also excelled in the anaerobic capacity test, but the difference between it and the third treatment group was very close, meaning that the stimulation of the lower limb muscles (thighs) had a limited difference in muscle fiber recruitment.
- By using the Cohen's d coefficient in statistically analyzing the results, it became clear that the differentiation is not only statistically significant but also practically significant.
- The role of linking the quantitative analysis of results with the physiological aspect of muscles toward selecting the best stimulation according to performance requirements is demonstrated.

Recommendations

In light of the results and conclusions reached by the researcher, the researcher recommends the following:

The necessity of muscle stimulation after completing the general warm-up using stimulation methods such as low-intensity weights, resistance bands, and electrical stimulation (EMS) due to their significant role in benefiting from muscle fiber stimulation, thereby improving the anaerobic capacity (vertical jump) of advanced basketball players.

- It is recommended to use weight-based stimulation after performing the warm-up due to its superiority over stimulation using rubber bands and electrical activation in anaerobic performance (vertical jump).
- Directing coaches to focus on various warm-up methods and stimulation using assistive tools to benefit from all muscle fibers and reduce joint and muscle injuries.
- Including in sports training courses for all sports the importance of warming up using stimulation and motivation methods, and the mechanism of applying them to players and their advantages.
- It is preferable to use another experimental design such as (Repeated Measures) for greater benefit in physical education research.
- It is recommended to adopt the factorial design used in this study (One Way ANOVA) on other samples.

References

1. Al-Hazaa HM. The physiological basis of warm-up: The comprehensive sports library; 2024.
2. Hafiz MMH. Development of some defensive tactical performances and their impact on the defensive performance of youth basketball players [Ph.D. Thesis]. Alexandria: University of Alexandria; 2013, p. 56.
3. Hafiz SN, Nasr D. The effect of EMS using an electrical muscle stimulation device for special exercises in developing some physical abilities in chair fencing. Al-Mustansiriya J Sports Sci. 2020;2(2):64.
4. Hassan AM. Physiology of sports. Cairo: Dar Al-Fikr Al-Arabi; 2004, p. 45.
5. Systematic review and meta-analysis: the effect of muscle warm-up on voluntary and evoked force-time parameter. Sport Health; 2025.
6. Effect of warm-up exercise on functional regulation of motor unit activation isometric torque production. J Hum Kinet; 2024.