The effect of a dynamic balance program on some physiological and physical variables and the digital level of triple jump players in athletics

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Introduction and Research Problem:

Rapid developments in sports activities, understanding their precise characteristics, and establishing developmental methods aim for optimal performance. Continued competition at high sports levels reveals motor problems related to technical performance nature and standards. Motor performance in sports activities is an accurate indicator of an individual's voluntary control of technique "morphological (physical), physiological (functional), mechanical (motor), psychological, and mental" to achieve motor skill requirements as per their technical design at various stages (405:8).

Abou Alaa Abdel Fattah and Ahmed Nasr Al-Din (2003) state that anaerobic training is muscular work dependent on anaerobic energy production. When motor performance demands maximum speed or strength, oxygen delivery to working muscles fails to meet the rapid energy requirement, leading to anaerobic energy production. This involves two systems: the phosphagen system (ATP-PC) responsible for fast energy production for activities lasting up to 30 seconds, and the lactic acid system responsible for activities up to 1–2 minutes (149:1). Balance plays a critical role in sports as it ensures equilibrium. The human body relies on the vestibular fluid within the ear (vestibular system) for balance (101:2).

Mahmoud Ismail (2015) highlights that balance during motor performance generates muscle coordination, reducing non-functional muscle activity during skill execution, thereby enhancing skill performance (182:9).

Athletics were born with the first human, who needed skills such as walking, running, jumping, and throwing. These four skills were the primary and essential means of survival for humans in their struggle alongside nature. Initially random efforts for survival, living, and preserving their kind, these skills evolved with human and cultural development into modern athletics. Today, athletics encompass 33 events (10:5).

Marco (2010) notes that the triple jump consists of a series of different movements, including the hop, step, and jump. These movements result in specific trajectories during the flight and landing phases. The goal is to achieve a horizontal distance while performing a set of connected phases without interruption. These phases include the approach, followed by three successive jumps (the hop, step, and jump). This requires a high level of strength combined with speed, while adhering to competition rules (13:338).

The secondary education phase typically begins between the ages of 15 and 18. Before this phase, the puberty stage begins, during which girls gradually regain balance after experiencing confusion and motor instability in middle school. During this stage, the body of the girl visibly becomes more proportionate.

At this stage, various motor skills improve significantly, reaching a high level of quality. This phase represents a new peak in motor development, enabling girls to learn and master various movements. The most suitable exercises for the secondary school stage include system exercises, structural exercises, motor learning exercises, agility exercises, balance exercises, and exercises using tools (7:91).

Research Problem:

Through the researcher's work as a senior sports specialist at the Directorate of Youth and Sports in Minya Governorate, and by observing training sessions, following up on school sports championships, and supervising them, the researcher noticed that triple jump female athletes in the preparatory and secondary sports school in Minya suffer from a decline in physical fitness specific to the triple jump competition. They also struggle with maintaining motor balance during performance, leading to a lower technical and skill level, reduced achievement, and poor numerical results. This has hindered their ability to improve athletic performance and achieve records.

This issue prompted the researcher to find a solution to enhance the physical and skill levels of the athletes, aiming to develop a well-rounded generation of competitors. Based on the researcher's review of related studies, it was found that anaerobic power exercises play an effective role in improving physical fitness. The results of these studies indicated that regular practice of such exercises significantly improves motor balance and enhances the athletes' numerical performance.

Hence, the research problem is evident: through the researcher's work and supervision of athletics championships, it was observed that most female athletes lack the attribute of motor balance, which is reflected in their low performance and numerical results during training and competitions. This motivated the researcher to design an anaerobic power training program to develop motor balance, a crucial physical component in all stages of the triple jump competition. This would ensure a distinctive performance and prevent technical errors that could lead to failed attempts.

Therefore, the importance of anaerobic power exercises lies in their role in enhancing motor balance, improving the athletes' ability to complete the phases of the triple jump as a cohesive and skilled motion sequence, and thereby raising their numerical performance, achieving greater accomplishments, and reaching higher athletic levels. Additionally, it highlights the necessity of adopting modern training methods instead of relying on traditional approaches to achieve sporting excellence.

Research Objective:

The research aims to design an anaerobic power training program and investigate its effects on:

1. Motor balance of triple jump athletes.
2. Numerical performance of triple jump athletes.

Research Hypotheses:

In light of the research objective, the researcher hypothesizes the following:

1. There are statistically significant differences between the mean ranks of the pre- and post-measurements of the study group in the motor balance test, in favor of the post-measurement.
2. There are statistically significant differences between the mean ranks of the pre- and post-measurements of the study group in the numerical performance test, in favor of the post-measurement.

Terms Used in the Research:

Anaerobic Training:

Anaerobic training is defined as the chemical changes that occur in the working muscles to produce the energy required for physical exertion without the use of atmospheric oxygen (275:4).

Motor Balance:

Motor balance is the ability of an individual to transition from one place to another while maintaining the center of gravity of their body, along with any tools they are carrying or using, within the center of their base of support, regardless of how small this base may be, and despite external factors negatively affecting balance (329:8).

*Numerical Performance:

Numerical performance refers to the numerical value of the best achievement accomplished by an athlete during a competition. In the triple jump, it represents the longest horizontal distance achieved, measured in meters.

Previous Studies:

Studies in Arabic:

1 - Reham Mohamed's study (2022) (4) entitled "The effect of anaerobic training to develop some special physical abilities on the speed of completing the quick attack for female handball juniors." The study aims to identify the effect of anaerobic training to develop some special physical abilities on the speed of completing the quick attack for female handball juniors. The researcher used the experimental method. The research sample was selected intentionally from female handball juniors born in (2006), and their number was (12) juniors. The research tools included devices, namely (restamometer, medical scale, multi-station weights, dumbbells, medicine balls, boxes, stopwatch, measuring tape), and the physical tests are (medicine ball push, vertical jump, balance, zigzag running, trunk and thigh flexibility), and the skill tests included the individual quick attack speed test, and the extended quick attack speed test. The results of the study confirmed the existence of statistically significant differences between the pre- and post-measurements of the members of the basic research sample in special physical abilities, in favor of the post-measurement, in addition to the existence of statistically significant

differences between the pre- and post-measurements of the members of the basic research

*Procedural Definition

sample in the speed of completing the quick attack in handball, in favor of the post-measurement.

2- The study of **"Haitham Ahmed" (2019) (11) entitled "The effectiveness of using anaerobic exercises on some physiological variables and the level of performance among wrestling players"**, the study aims to know the effectiveness of using anaerobic exercises on some physiological variables and the level of performance among wrestling players, the researcher used the experimental method using the experimental design for two groups, one experimental and the other control, to suit the nature and objectives of the research. The research sample was selected intentionally from the first-class wrestlers at the Barakat Al-Sabaa Sports Club in the city of Barakat Al-Sabaa and registered with the Egyptian Wrestling Federation, as well as karate players registered at the Barakat Al-Sabaa Sports Club in the Menoufia region for karate. The sample included (25) players, including (12) players for the basic research sample, who were divided into two groups, each consisting of (6) players, one experimental and the other control. The size of the exploratory research sample was (10) players from the same research community and outside the basic research sample to conduct exploratory studies and scientific transactions for the tests under study. The researchers also excluded (3) players for their irregularity in training. The results of the study showed that the proposed training program applied to the experimental group showed a significant improvement in some physical variables (general endurance, speed endurance, motor speed of the Aoi Zuki skill, speed-specific strength, balance, general and specific agility) and in physiological variables (resting pulse, systolic and diastolic blood pressure, red blood cells, hematocrit, lactate ratio, vital capacity, cardiac output, stroke volume, pulmonary ventilation, oxygen pulse, relative maximum oxygen consumption, pulmonary ventilation coefficient, volume of oxygen consumed).

3- **Hashem Yasser's study (2014) (10) entitled "The effect of anaerobic exercises on some functional and physical variables of football players"**, the study aims to identify the effect of anaerobic exercises on some functional variables (heart rate, lactic acid ratio, anaerobic capacity) and some physical variables (maximum speed, speed endurance, speed-

specific strength) in a sample of Al-Quwa Al-Jawiya Youth Football Club players, numbering (20) players, who were divided into two experimental and control groups. The researcher used the experimental method, and the duration of the program was (8) weeks, with three training units per week, and a total of (24) training units, and the duration of each training unit was (90) minutes. The training program was implemented in the period before the competitions and during the competitions, and the training was focused on physical qualities, and it was emphasized when setting the exercises to maintain the highest level when executing the movements from one repetition to another, which leads to a good state of recovery, and the most important results of the study are the positive effect of anaerobic exercises on some functional, physical and skill variables For football players.

Second: Foreign Studies

1. **Study by Michael Riebold, William Muirhead, and Others (2023) Titled "Effects of Different Types of High-Intensity Anaerobic Exercises on Dynamic Balance Performance",** this study aimed to identify the impacts of various types of high-intensity anaerobic exercises, such as running, squats, and jumping, on dynamic balance performance. Twenty-five college-aged student-athletes participated in three types of high-intensity anaerobic exercises (treadmill sprints, squats, and vertical jumps) over three separate days, with only one exercise performed per week in a randomized order. The study concluded that dynamic balance ($t = 2.21$, $p = 0.04$) worsened from the pre-test to post-test following the vertical jump protocol (5.24±2.29 and 6.1±1.92, respectively). However, no significant differences ($t < 1.75$, $p < 0.19$) were observed in dynamic balance from the pre-test to post-test after treadmill sprints (5.68±1.68 and 6.28±2.06, respectively).
2. **Study by Mustafa Özdal and Maan Hassan (2017) Titled "Acute Effects of Anaerobic Exercises with Different Intensities on Dynamic Balance Performance",** the purpose of this study was to investigate the acute effects of anaerobic exercises with varying intensities on dynamic balance performance. Twenty sedentary men, aged 23.70±1.45 years, voluntarily participated in this study. A randomized crossover design was used as the experimental design. A dynamic balance test using a motion balance device with a dominant single-leg test was conducted to measure dynamic balance. To induce anaerobic exercise effects, the Wingate Anaerobic Power Test was performed at different loads. Dynamic balance performance was

measured once before the anaerobic exercise trials. Over the next four days, anaerobic exercise trials with varying intensities were applied to create acute anaerobic effects. Immediately after all trials, the dynamic balance test procedure was conducted. Data analysis included repeated measures of variance analysis and LSD post-hoc correction tests.
Results showed that anaerobic exercise trials at 10.0% and 7.5% intensities led to significant reductions in total balance and anterior-posterior balance scores ($p < 0.05$). Similarly, 10.0%, 7.5%, and 5.0% intensities caused significant reductions in medio-lateral balance scores ($p < 0.05$). Furthermore, while balance scores increased in the 10.0% anaerobic exercise trial, they gradually decreased at the 7.5% intensity. The study concluded that dynamic balance is positively influenced by low-intensity anaerobic exercises but negatively impacted by high-intensity anaerobic exercises.

Research Procedures:

- **Research Methodology**:
  Based on the research nature and objectives, the researcher will use the experimental method with a one-group pre-test and post-test design, which is suitable for the nature of the study and research.
- **Research community and sample**:
  The research population consists of female triple jump athletes in athletics (secondary school level) at the preparatory and secondary sports school for girls in Minya Governorate, aged 16–18 years, with a total of 12 triple jump athletes. The research sample was intentionally selected from the population and consists of 6 athletes. Additionally, 6 athletes were chosen as a pilot study sample.

. • **Tests Used in the Research**:

- Dynamic Balance Test (Modified Bass Test).
- Measurement Test for the Numeric Level of Triple Jump Athletes.

- **Research Tools**:

The researcher calculated the scientific coefficients for the dynamic balance test and numeric level test, assessing validity and reliability during the period from January 7 to January 11, 2024, as follows:

- **Scientific Validation of the Test:**

A. Validity:

To calculate the validity of the test, the researcher used the discriminant validity method. The test was applied to the exploratory sample (6 athletes), which was divided into two groups: one consisting of athletes with a high level of performance in triple jump and the other with a lower performance level. The researcher then calculated the significance of differences between the two groups, as shown in Table (1).

Table (1)
Significance of Differences Between High and Low Performing Athletes in the Physical Test (N=6)

Variables	Unit of Measurement	Distinguished			Less Distinguished			Z-Value	Significance Level
		Mean	Mean Ranks	Sum of Ranks	Sum of Ranks	Mean Ranks	Mean		
Modified Bass Test	Degree	44.33	5.00	15.00	6.00	2.00	42.00	1.99	0.046

Significant at the (0.05) level

It is evident from Table (1) that there are statistically significant differences between the high-performing and low-performing athletes in the physical test, favoring the high-performing athletes. This indicates the validity of the test under investigation and its ability to distinguish between the two different groups.

B. Reliability:

To calculate the reliability of the test under investigation, the researcher used the test-retest method. This method was applied to a sample of 6 athletes outside the research sample, but with the same characteristics as the original sample. There was a time gap of 3 days between the first and second applications. Table (2) shows the correlation coefficients between the two applications.

Table (2)
Correlation Coefficient Between the First and Second Applications of the Physical Test (N=6)

Correlation Coefficient	Second Application		First Application		Unit	Test
	SD	Mean	SD	Mean		
0.94	1.97	42.00	1.47	43.17	Points	Bass Rate

Correlation Value (r) at Significance Level (0.05) = 0.811

It is evident from Table (2) that the correlation coefficients between the first and second applications of the test under investigation ranged between (0.98 and 0.91), which are statistically significant correlation coefficients, indicating the reliability of the test.

Test for Measuring the Numeric Level of Triple Jump Athletes:

The researcher conducted the test for measuring the numeric level of triple jump athletes in track and field before and after applying the training program.

- The test was conducted according to the International Rules for Track and Field.

Scientific Variables of the Test:

A. Validity:

To calculate the validity of the test, the researcher used discriminant validity. The test was applied to the exploratory sample of 6 athletes, dividing them into two groups: one group of high-level athletes in triple jump and another group of lower-level athletes. The researcher then calculated the significance of the differences between the two groups, as shown in Table (3).

Table (3)
The significance of the differences between the distinguished and the less distinguished in the test measuring the digital level of triple jumpers (n=6)

Test	Unit of Measurement	Distinguished			Less Distinguished			Z-Value	Significance Level
		Mean	Mean Ranks	Sum of Ranks	Sum of Ranks	Mean Ranks	Mean		
Digital Level for Triple Jump Players	cm	8.25	5.00	15.00	6.00	2.00	8.03	1.96	0.050

Significant at the (0.05) level

It is evident from Table (3) that:

There are statistically significant differences between the elite and less elite athletes in the measurement test for the triple jump level, in favor of the elite athletes. This indicates the validity of the test in question and its ability to distinguish between the two different groups.

B - Reliability:

To calculate the reliability of the test, the researcher used the method of test-retest, applied to a sample of 6 athletes outside the research sample, but with the same characteristics as the original sample. The interval between the first and second applications was three days. Table (4) shows the correlation coefficients between the two applications.

Table (4)
Correlation coefficient between the two applications of the digital level test for triple jump athletes (N=6)

Test	Unit of Measurement	First Application		Second Application		Correlation Coefficient
		Mean	SD	Mean	SD	
Digital Level for	cm	8.14	0.14	8.17	0.11	0.96

Triple Jump Players						

- **Value of (r) at significance level (0.05) = 0.811**

From Table (4), it is evident that:

- The correlation coefficient between the two applications in the test under investigation is (0.96), which is statistically significant, indicating the stability of the test.

Statistical Methods Used:

- Mean
- Median
- Standard Deviation
- Skewness Coefficient
- Mann-Whitney non-parametric test
- Correlation Coefficient
- Wilcoxon non-parametric test
- Percentage Change Ratio

The researcher has adopted a significance level of (0.05), and used the SPSS program to calculate some statistical coefficients.

Training Program:

- **Program Objective:**

The program aims to use anaerobic capacity exercises to impact the balance of movement and the digital level of triple jump athletes.

- **Foundations for Program Design:**

After reviewing scientific references and previous studies, the researcher derived the principles on which the training program would be based, which include:

- **Defining the general goal of the program:**
  - To achieve the goal for which the training program was designed.
  - Ensure that the program's goal aligns with each stage's specific objectives.
  - Ensure that the proposed program is suitable for the age and gender of the selected sample.

Steps for Preparing the Program:

- Determine the duration of the program's weeks.
- Define the components of the daily and weekly training load.
- Define the training load cycle.
- Define the total program time.
- Distribute the total program time across its tasks.
- General framework for the program after determining the percentage for physical preparation, skill training, and the time allocated for each.
- Distribution of physical and skill preparation time across the program weeks, including the training load cycle.
- Allocate time for general and specific physical preparation across the weeks of the program.
- Determine the appropriate time for each physical attribute and its percentage.

Program Time Planning:

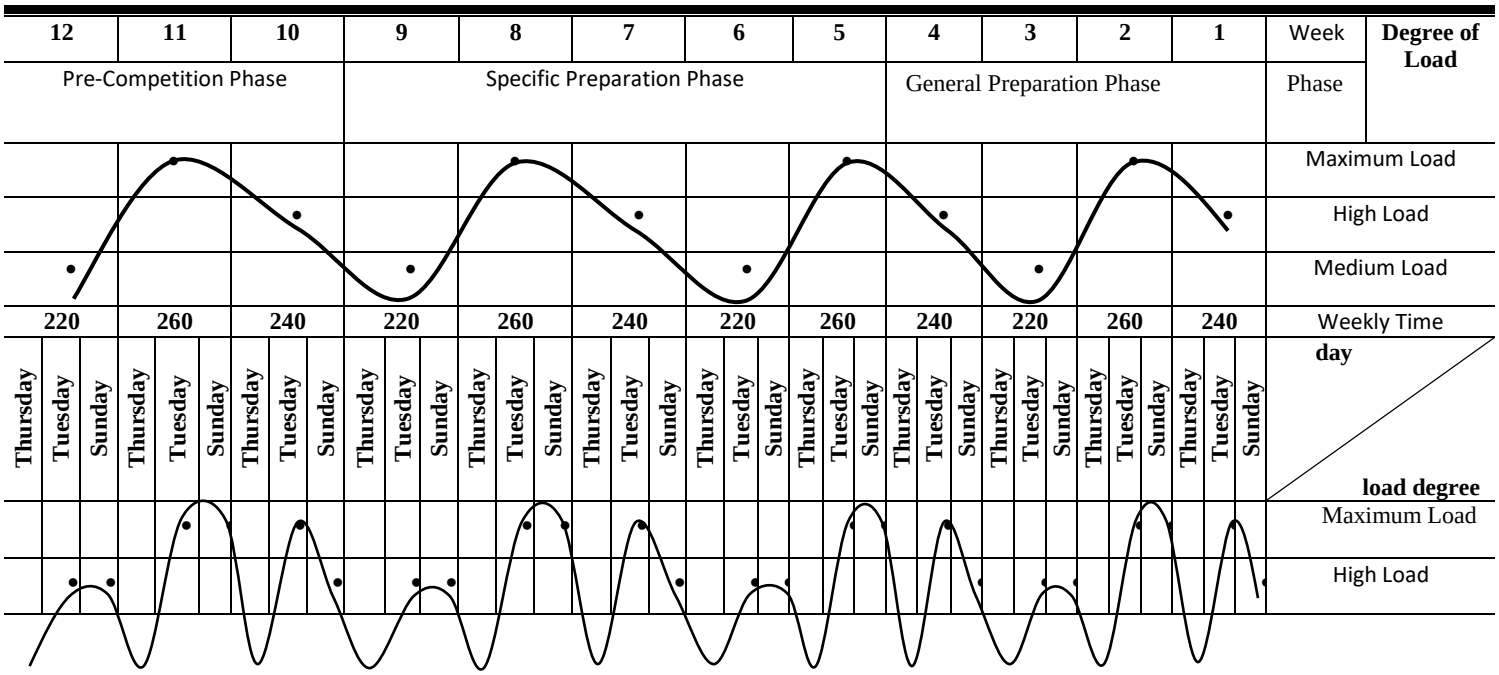
- Program Duration: 12 weeks
- Number of Training Units: 3 units per week
- Total Training Units: 36 t
- Training Days: Sunday, T day
- Training Unit Duration: (60-100 minutes)

Table (5)
Determining the Total Training Program Time from the Weekly Training Load Time

Load Degree	Weekly Load (minutes)	Number of Weeks	Total Time in Program (minutes)
Max Load	260 minutes	4 weeks	1040 minutes
High Load	240 minutes	4 weeks	960 minutes
Medium Load	220 minutes	4 weeks	880 minutes
Total		12 weeks	2880 minute

- Total program time is the sum of the times from the twelve weeks: Total Program Time = 1040 + 960 + 880 = 2880 minutes.

Note: The preparatory and final parts are outside the total program time.



•			•			•			•			•			•			•			•			•			•			•			Medium Load
min 60	min 80	min 80	min 60	min 100	min 100	min 60	min 100	min 80	min 60	min 80	min 80	min 60	min 100	min 100	min 60	min 100	min 80	min 60	min 80	min 80	min 60	min 100	min 100	min 60	min 100	min 80	min 60	min 80	min 80	min 60	min 100	min 100	min 60	min 100	min 80	Unit time in minutes

Table (6)
Distribution of Training Load Degree and Load Cycles (1:2) over Program Weeks

Table (7)
Percentage Distribution for Physical and Skill Preparation and Time Allocation over the Training Program

Preparation Type	Percentage	Percentage Calculation Formula	Time Allocated (Minutes)
Physical Preparation	60%	60 × 2880 / 100	1728 minutes
Skill Preparation	40%	40 × 2880 / 100	1152 minutes
Total	100%		2880 minutes

First: Presentation and Discussion of the Results of the First Hypothesis

Table (8)
Significance of the Differences Between the Mean Ranks of the Pre-Test and Post-Test Measurements for the Group Under Study in the Physical Test (N=6)

Test	Unit of Measurement	Pre-Test Average	Post-Test Average	Average Ranks	Total Ranks	Sign Direction	Z-value	Level of significance	Improvement percentage
Bass rate	Degree	43.67	86	0.00 3.50	0.00 21.00	- Zero + Six = Zero	2.21	0.027	96.93%

Significant at the (0.05) Level

It is clear from Table (8) the following:

- Statistically significant differences exist between the mean ranks of the pre-test and post-test measurements for the group under study in the physical test, in favor of the post-test measurement.

From Table (8), it is evident that:

- The percentage improvement between the mean pre-test and post-test measurements for the group under study in the physical test ranged between (11.93% and 96.93%), indicating the positive effect of the proposed training program on improving the physical test for the study sample.
- Table (9) shows an improvement in the physical variable, represented by the dynamic balance test using the Bass method. The researcher attributes this result to the practice of anaerobic capacity exercises for the triple jump athletes. "Ahmed Samir" (2019) indicates that balance is an important factor in sports, as it plays a crucial role in various sports. It means staying in a state of equilibrium, and the responsibility for balance in the human body lies with what is called the vestibular fluid, found inside the ear.

This is consistent with the study of "Reham Mohamed" (2022), which confirmed that there were statistically significant differences between the pre-test and post-test measurements of the study sample who used anaerobic exercises, positively affecting their physical abilities, in favor of the post-test measurement.

This also aligns with the study by "Maan Hassan, Mustafa Ozal" (2017), which concluded that dynamic balance is positively affected by low-intensity anaerobic exercises, while it is negatively affected by high-intensity anaerobic exercises.

The researcher clarifies that the results of the studies and the post-test measurement of the experimental group demonstrate a positive effect of anaerobic capacity exercises and a clear impact on a key physical element for athletes, especially triple jumpers, which is dynamic balance, as evidenced by the Bass method test.

- Thus, the first hypothesis is confirmed, which states: There are statistically significant differences between the mean ranks of the pre-test and post-test measurements for the experimental group in the physical test, in favor of the post-test measurement.

Second: Presentation and Discussion of the Results of the Second Hypothesis

Table (9)
Significance of the Differences Between the Mean Ranks of the Pre-Test and Post-Test Measurements for the Group Under Study in the Measurement of the Numeric Level for Triple Jump Athletes (N=6)

Test	Unit of Measurement	Pre-Test Average	Post-Test Average	Average Ranks	Total Ranks	Sign Direction	Z Value	Significance Level	Improvement Percentage

Digital Level for Triple Jump Athletes	cm	8.03	8.41	0.00 3.50	0.00 21.00	-Zero +6 =Zero	2.20	0.028	4.73%

Significant Differences at the (0.05) Significance Level

It is evident from Table (9) the following:

- There are statistically significant differences between the pre-test and post-test means of the ranks for the group under study in the test measuring the numerical level of the triple jump athletes, in favor of the post-test.
- From Table (9), the following can be noted: The percentage of improvement between the pre-test and post-test means for the group in the test measuring the numerical level of the triple jump athletes was 4.73%, which indicates the positive effect of the training program in improving the numerical level test for the research sample. Table (9) shows a positive improvement in the numerical level of the athletes. The researcher attributes this result to the athletes' regular participation in the anaerobic exercise program, which led to an improvement in both their technical and skill levels. This was clearly reflected in the numerical level measurement test results. "Mahmoud Ismail" (2015) states that balance during motor performance produces a kind of muscular coordination and reduces the activity of non-working muscles during skillful performance, all of which help athletes improve their skill performance. This result is consistent with the study by "Haitham Ahmed" (2019), which showed that the anaerobic exercise training program applied to the experimental group led to a significant improvement in certain physical variables and performance levels of the athletes. Additionally, the study by "Hashem Yasser" (2014) found the positive impact of anaerobic exercises on some functional, physical, and skill variables for football players. The researcher emphasizes that the positive results observed in the experimental group support the importance of anaerobic capacity exercises in improving skill levels and thus enhancing the athletes' numerical level, which was clearly evident in the post-test results.
- Therefore, the second hypothesis is confirmed, which states: There are statistically significant differences between the pre-test and post-test means of the group under study in the test measuring the numerical level of the triple jump athletes, in favor of the post-test.

Conclusions:

1. The anaerobic exercise program led to improvements in the motor balance and numerical level of the triple jump athletes in track and field.
2. Statistically significant differences exist between the pre-test and post-test means of the group under study in the physical test, in favor of the post-test.
3. Statistically significant differences exist between the pre-test and post-test means of the group under study in the numerical level test, in favor of the post-test.

Recommendations:

1. Focus on implementing anaerobic exercise programs that are suitable for various age groups of triple jump athletes, as they improve physical variables and the athletes' numerical level.
2. Conduct further studies on the implementation of anaerobic capacity programs in all track and field events.
3. The current study recommends adopting anaerobic exercise programs by triple jump coaches to positively influence the athletes and help achieve athletic success and victories.

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