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THE EFFECTIVENESS OF A PROPOSED TRAINING PROGRAM FOR DEVELOPING MOTOR AND PHYSICAL CAPABILITIES AND CERTAIN MOVEMENTS ON THE PARALLEL BARS FOR STUDENTS

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ABSTRACT
This research examines the effectiveness of a proposed training program designed to develop the physical and motor capabilities and improve specific movements on the parallel bars for third-year students at the College of Physical Education and Sports Sciences, University of Kufa. The researcher employed an experimental method using an equivalent group design, dividing the sample into experimental and control groups to evaluate the impact of the training program, which lasted eight weeks with three sessions per week. Physical capabilities such as explosive power, agility, and flexibility were assessed through standardized pre- and post-tests. The results revealed a significant improvement in the experimental group compared to the control group, demonstrating the program's effectiveness in enhancing motor and physical abilities and improving the technical execution of required parallel bar movements. This confirms the impact of targeted exercises in developing the necessary physical and motor skills.

KEYBOARD: *Parallel Bars Training, Motor and Physical Capabilities, Gymnastics Performance*

1. INTRODUCTION

1.1 Introduction and Research Importance:

The growing interest shown by studies and research in physical education, sports, and motor skills has reflected the progress in athletic achievements across various competitions, particularly individual sports that rely on numerical results as indicators of distinguishing levels among champions in sports competitions and international championships. These aim to fulfill aspirations and ambitions in various fields of life, including sports. The process of development involves defining the type of activity, skill, or movement to be improved, the level of development, experience, and gender.

The progress in gymnastics has resulted from advancements in technical and research aspects, enabling athletes to perform complex and challenging skills.[1] These relationships between physical and motor abilities serve as foundational work plans for our coaches and athletes to develop these abilities according to available resources and capabilities. The significance of this research lies in designing proposed training programs for student teams and addressing one of the important training aspects due to its positive impact on the athletes' performance on the parallel bars. Additionally, the study aims to determine the results that could assist in guiding player preparation based on scientific principles to achieve Olympic medals for the benefit of the nation.

1.2 Research Problem:

Through the researcher's observation of gymnastics players' performance levels and his continuous and ongoing attendance at player team training sessions, he noted a weakness and inconsistency in the technical performance of some required movements on the parallel bars, particularly the front and back "Bryce" press to support and angle support. These movements form the basis for other movements on the apparatus. The researcher attributes this issue to deficiencies in the physical preparation and specific physical and motor capabilities related to the practiced activity, particularly in terms of elements such as specific muscular strength, flexibility, and agility, as many coaches neglect or inconsistently focus on these elements.

1.3 Research Objectives:

1. To design a proposed training program aimed at developing the specific physical and motor capabilities for certain movements on the parallel bars for students.
2. To determine the impact of the proposed program on the development of the specific physical and motor capabilities for certain movements on the parallel bars for students.

1.4 Research Hypotheses:

The proposed program positively impacts the development of specific physical and motor capabilities for certain movements on the parallel bars for students.

1.5 Research Fields:

- **Human Field:** Third-year students at the College of Physical Education and Sports Science, University of Kufa, during the academic year 2022-2023.
- **Spatial Field:** The gymnastics hall at the College of Physical Education and Sports Science, University of Kufa, during the academic year 2022-2023.
- **Temporal Field:** From October 1, 2022, to March 1, 2023.

2. RESEARCH METHODOLOGY AND FIELD PROCEDURES

2.1 Research Method

The researcher used the experimental method, employing one of its fundamental designs known as the "equivalent group design" due to its suitability for the nature of the research problem.

2.2 Research Population and Sample

The research population was defined as third-year students at the College of Physical Education and Sports Science, University of Kufa, during the 2021-2022 academic year, totaling 85 students, representing the entire population. The research sample was randomly selected, consisting of 30 students. These students were divided randomly using a lottery to avoid researcher bias. Odd-numbered participants were placed in the experimental group, while even-numbered participants were placed in the control group, with 15 students in each group. The experimental group received the proposed training program, while the control group followed the training program prepared by the course instructor.

Table 1. Demonstrates the equivalence of the research sample groups (experimental and control) in all research variables, along with the computed and tabulated Mann-Whitney values for the pre-test results and the type of statistical significance.

Variable	Unit of Measurement	Experimental Group Median	Interquartile Deviation	Control Group Median	Interquartile Deviation	Calculated (Y)	Statistical Significance
Speed-Specific Strength	Time/Count	11	1.25	13	2.5	38	Random
Explosive Power	Meters/Centimeters	1.20	0.125	1.20	0.051	27.5	Random
Flexibility	Meters/Centimeters	21	2.05	21	2.05	33.5	Random
Agility	Seconds	24.10	0.987	23.11	0.995	24	Random
Front Bryce	Points	5.5	0.625	5	1.625	40.5	Random
Back Bryce (for Transition)	Points	4.5	1	6	1.75	20	Random

2.3 Information Collection Tools, Devices, and Equipment

2.3.1 Information Collection Tools

- Arabic and foreign sources.
- The Internet.
- Personal interviews.
- Observation, experimentation, tests, and measurements.
- Computer software and SPSS for statistical equations.
- Expert opinion forms for selecting specific capabilities and for data collection and organization.

2.3.2 Devices and Equipment Used:

- Sony video camera (1 unit).
- Measuring tape and medical scale (Chinese brand).
- 2 kg medicine ball, chair, binding strap, and marking tools (chalk, plaster, adhesive tape).
- Four foam mats.
- Two small parallel bars for handstands and control.
- Official parallel bars apparatus and floor parallel bars apparatus.

- Pull-up bar, half-cylinder box, wooden stairs, and rubber rope (1 unit).
- Diamond electronic stopwatch and a P4 electronic calculator (1 unit).
- 1-meter geometric ruler and a half-meter high wooden box (1 unit).

2.4 Research Execution Methodology

2.4.1 Defining Variables Related to Physical Performance

The researcher relied on references and resources related to sports training in gymnastics to define the most important variables for physical performance. These variables were included in a survey form and presented to experts and specialists in tests, measurements, sports training, and gymnastics. After collecting and processing the forms statistically, variables with a score of 55% or higher were accepted.[2]

The researcher also prepared a survey form to determine the tests related to the studied variables and presented it to experts. After collecting and organizing the forms, the relative importance of each test was extracted, and tests scoring 50% or higher were accepted.

2.4.2 Defining Variables Related to Skill Performance

1. Forward swing from the arms to angle support on the parallel bars.
2. Backward swing from the arms to transition and angle support on the parallel bars.

These two skills were selected not through a questionnaire but rather through observation and the researcher's expertise in teaching, in collaboration with the team coach and judges from the gymnastics sub-federation. These skills were determined as the primary requirements for parallel bar movements, as highlighted in the research problem.

2.4.3 Test Sequence

Due to the number of tests and the effort required from the participants, the researcher consulted scientific references related to sports training, tests, and measurements, as well as gymnastics-specific training sources. A proposed survey form regarding the sequence of tests was designed and presented to gymnastics training and testing experts. Based on their feedback, the tests were organized according to expert recommendations.

2.4.4 Tests Used in the Research

The researcher employed a set of physical, motor, and skill-related tests. To clarify these tests, the researcher presented definitions from experts regarding test concepts. By reviewing Arabic and foreign sources related to physical and motor capabilities, the researcher selected tests to measure strength in gymnastics, including specific strength-speed components and explosive power. Additionally, reaction speed tests were used to measure response capabilities, alongside flexibility and agility tests. Skill tests included performing forward and backward swings to angle support, aiming to achieve the required parallel bar movement scores and a final grade.

2.5 Scientific Basis for the Tests[3]

The researcher aimed to apply scientific principles to standardize the tests, ensuring their validity, reliability, and objectivity.

2.5.1 Test Validity

To ensure test validity, the researcher used intrinsic validity, defined as "the validity of experimental test scores compared to the true scores free from measurement errors." True scores are the criterion for validity and are measured by calculating the square root of the test reliability coefficient.

2.5.2 Test Reliability

Reliability is a fundamental component of a good test. According to Mohamed Sobhi (citing Vandevelde), "A test is considered reliable if it consistently yields the same results when repeated under the same conditions." Reliability reflects the degree of confidence in the test's stability during repetition. Takman affirms that "the method of test-retest application is credible in experimental research."

Table 2. Shows the reliability and intrinsic validity coefficients for the research tests.

No.	Test Name	Unit of Measurement	Test 1 (Mean ± SD)	Test 2 (Mean ± SD)	Reliability	Intrinsic Validity
1	Explosive Power	Meters/Centimeters	1.23 ± 0.152	1.31 ± 0.125	0.98	0.99
2	Speed-Specific Strength	Repetitions	11.66 ± 1.154	12.33 ± 0.577	0.94	0.969
3	Flexibility	Meters/Centimeters	20.66 ± 2.081	21 ± 1	0.91	0.95

4	Agility	Seconds	24.11 ± 0.975	24.01 ± 0.974	0.95	0.97

The reliability coefficient was calculated using the test-retest method. After seven days, the test was repeated under the same conditions during the pilot study. The correlation coefficient (Spearman's rank correlation) was computed between the first and second test results, showing a high correlation as the computed values exceeded the critical value of 0.67%.

2.5.3 Test Objectivity

A test is objective if it provides consistent scores regardless of the examiner. An objective test "yields the same results no matter who the examiner is, ensuring that results are unaffected by examiner bias.[4] The tested participant receives the same score even if the test is scored by different examiners.

2.6 Pilot Study for Filming and Test Trials

The pilot study was conducted with three students from the research sample at 10:00 AM in the gymnastics hall of the College of Physical Education and Sports Science, University of Kufa. A camera was used to record the experimental performance of the two skills, and these students were excluded from the main pre-tests.

The purpose of the pilot study was to:

- Determine the camera's angles and the athlete's range of movement.
- Assess the image clarity and data accuracy.
- Ensure the functionality of the equipment.
- Identify the time required for each test and the total test duration.
- Ensure the competence of the supporting team.
- Verify the test sequence.
- Identify obstacles to be addressed during the main filming.
- Confirm the validity of the tests.
- Verify the suitability of the test environment.

The pilot study lasted one day and resulted in the following conclusions:

- Division of tests into groups.
- Suitability of the tests for the research sample.
- Appropriateness of the test sequence according to expert opinions.
- Suitability of the parallel bars equipment used in the research.

2.7 Research Procedures

2.7.1 Pre-Tests for the Research Sample

The researcher conducted a series of tests to serve as indicators for the players' physical strength, particularly the speed-specific strength of the abdominal muscles, explosive power of the upper limb muscles, body flexibility, and overall agility. Additionally, skill-based tests were used to measure the players' progress in specific parallel bars movements. The selection of these tests was based on expert opinions and scientific references.

2.7.2 Proposed Training Program

The content of the proposed training program is detailed as follows:

- The first training session was conducted immediately after the pre-tests.
- The researcher developed a training program designed to enhance specific physical and motor capabilities and skill-based exercises related to movements on the parallel bars.
- The program lasted for **8 weeks**, with **3 training sessions** per week (Sunday, Tuesday, and Thursday). Each session lasted **25-35 minutes**, amounting to **24 training units** over two months, totaling **720 minutes (12 hours)** dedicated to developing physical and motor abilities and practicing skills.
- The researcher sought expert opinions in sports training and gymnastics and referred to Arabic and foreign sources to finalize and validate the program with sports training and gymnastics experts.
- The program aimed to develop the explosive power of the upper limb muscles, improve the speed-specific strength of the abdominal and upper limb muscles, and enhance joint flexibility and body agility through high-intensity interval training.
- The time allocated for the main section of the instructor's program was **85 minutes** for special physical and motor training, while the proposed training program used **25-35 minutes** per session, totaling **720 minutes (12 hours)**. The total time was equally divided between exercises for physical and motor abilities and skill-based exercises, which accounted for **122 minutes (2 hours)**.

The appendices include tables that detail the distribution of exercise times for both physical capabilities and skill-based exercises.

2.7.3 Post-Tests for the Research Sample

Post-tests (for physical, motor, and skill performance) were conducted in the gymnastics hall at the College of Physical Education and Sports Science, University of Kufa. The researcher ensured that the same conditions as the pre-tests were maintained, using the same devices, tools, measurements, and team members, including the same Sony video camera and its specifications.

2.8 Technical Performance Evaluation of Skills

The two movements were evaluated by agreement among the judging panel members. The final score for each movement was **10 points**. The use of a point-based evaluation system plays a significant role in gymnastics and is considered a key method for skill assessment based on observation.

2.9 Statistical Analysis Tools

The researcher employed the following statistical tools to analyze and interpret the research results using the SPSS statistical program.

3. PRESENTATION, ANALYSIS, AND DISCUSSION OF RESULTS

3.1 Presentation and Analysis of Explosive Power Test Results for the Experimental and Control Groups

Table 3. Demonstrates the median, interquartile deviation, and calculated and tabulated Wilcoxon values, along with the significance of differences in the pre- and post-tests for both groups.

Group	**Test**	**Calculated Wilcoxon Value**	**Tabulated Value**	**Significance**				
	Median	Interquartile Deviation	Median	Interquartile Deviation				
Experimental Group	Pre-test	1.20	0.125	1.70	0.132	0	5	Significant
Control Group	Pre-test	1.20	0.056	1.24	0.065	0	5	Significant

To test the significance of the differences between the pre- and post-tests for the research groups, the Wilcoxon signed-rank test was used. The results showed significant differences in favor of the post-test for the experimental group, with a calculated Wilcoxon value of **0**, which is smaller than the tabulated value of **5** at a significance level of **0.05** and a sample size of **9**. This indicates that the experimental group achieved significant improvement in this attribute of upper limbs.

Table 4. Demonstrates the median, interquartile deviation, coefficient of variation, and calculated and tabulated Mann-Whitney values for the post-test of explosive power for both groups.

Group	**Variable**	**Control Group Median**	**Interquartile Deviation**	**Coefficient of Variation**	**Experimental Group Median**	**Interquartile Deviation**	**Coefficient of Variation**	**Calculated (Y)**	**Tabulated (Y)**	**Significance**
Explosive Power	Post-test	1.24	0.065	7.67	1.70	0.132	5.24	0	17	Sig.

Since the coefficient of variation for the control group is higher than that of the experimental group, the experimental group showed a more consistent improvement.

3.2 Discussion of Explosive Power Test Results

The results indicate a statistically significant improvement in the experimental group, attributed to the effectiveness of the proposed training program, which included exercises aimed at enhancing the upper limb muscles' explosive power. The structured training plan demonstrated a positive impact on motor skill development on the parallel bars.

3.3 Presentation and Analysis of Speed-Specific Strength Test Results

Table 5. Demonstrates the median, interquartile deviation, and calculated and tabulated Wilcoxon values for the pre- and post-tests of speed-specific strength for both groups.

Group	Test	Calculated Wilcoxon Value	Tabulated Value	Significance				
	Median	Interquartile Deviation	Median	Interquartile Deviation				
Experimental Group	Pre-test	11	1.25	15	1.25	0	5	Significant
Control Group	Pre-test	13	2.5	15	1.75	12	5	Not Significant

The Wilcoxon test results showed significant differences for the experimental group but not for the control group.

Table 6. Shows Mann-Whitney test results for post-tests of speed-specific strength.

Group	Variable	Control Group Median	Interquartile Deviation	Coefficient of Variation	Experimental Group Median	Interquartile Deviation	Coefficient of Variation	Calculated (Y)	Tabulated (Y)	Significance
Speed-Specific Strength	Post-test	15	1.75	11.66	15	1.25	8.33	31.5	17	No sig.

Since the coefficient of variation for the control group is higher, it shows a lower consistency in improvement compared to the experimental group.

3.4 Discussion of Speed-Specific Strength Test Results

The researcher attributes the lack of significant differences in the control group to the players' inability to adapt sufficiently due to limited variety in exercises.

3.5 Presentation and Analysis of Flexibility Test Results

Table 7. Demonstrates the median, interquartile deviation, and Wilcoxon test results for flexibility tests.

Group	Test	Calculated Wilcoxon Value	Tabulated Value	Significance				
	Median	Interquartile Deviation	Median	Interquartile Deviation				
Experimental Group	Pre-test	21	2.52	26	2.75	0	5	Sig.
Control Group	Pre-test	21	2.5	23	1.62	6	3	No sig.

The discussion highlights the program's positive impact on flexibility due to the use of wide-range exercises and adherence to program guidelines.

3.6 Presentation and Analysis of Agility Test Results

Table 9. Demonstrates Wilcoxon test results for agility.

Group	Test	Median	Interquartile Deviation	Calculated Wilcoxon Value	Tabulated Value	Significance
Experimental Group	Post-test	22.33	0.750	0	5	Sig.
Control Group	Post-test	22.80	1	0	5	Sig.

The results indicate significant improvement in both groups, but more so in the experimental group, demonstrating the benefit of varied skill-based exercises.

3.8 Analysis of Skill Performance via Video Assessment

The two movements (forward and backward support) were recorded and assessed by a panel of **3 expert judges** and **1 international judge**. The assessment aimed to validate the study's hypotheses.

Table (11): Demonstrates Wilcoxon values for forward support movement.

Group	Test	Median	Interquartile Deviation	Calculated Wilcoxon Value	Tabulated Value	Significance
Experimental Group	Post-test	9	0.50	0	5	Sig.
Control Group	Post-test	7.5	0.625	6	5	No Sig.

The forward support movement showed significant improvement in the experimental group compared to the control group.

Table 12. Demonstrates Mann-Whitney values for post-tests of forward support movement.

Group	Median	Interquartile Deviation	Coefficient of Variation	Calculated (Y)	Tabulated (Y)	Significance
Experimental Group	9	0.50	5.55	4	17	Sig.
Control Group	7.5	0.625	8.33			

This indicates a greater improvement in the experimental group for forward support performance.

3.8.2 Discussion of the Evaluation Results of the Forward Support Movement for the Experimental and Control Groups

The absence of significant differences between the pre-test and post-test results for the control group, as shown in Table (12) for the forward support movement, is attributed by the researcher to the limitations of the coach's traditional program. Although slight progress was observed, the program did not adequately address the development of this specific requirement for the parallel bars through the enhancement of specific strength elements—particularly speed-specific strength related to physical capabilities and flexibility, which impacts the performance of this requirement. Additionally, the program relied on a single type of strength exercise without variation, causing player boredom and limiting improvements in muscle strength.[5]

The researcher cites that: "The biological challenge facing coaches is that an athlete may train for an entire season focusing solely on muscle strength development, yet the results may be negligible or may not correspond to the time and effort invested."[6]

Conversely, the presence of significant differences in the post-test evaluations for the experimental group, is attributed to the use of modern techniques to determine correct movement angles for the forward support trajectory. These techniques were incorporated into specific exercises using supportive learning aids. Furthermore, the specialized exercises provided several benefits, including repeated handstand practices on the floor parallel bars, transitions that reinforce starting positions for most parallel bar skills, and the correct descent using a back arch to prevent excessive forward shoulder movement, which aids in balance.[7]

Slowing down the movement allowed the player enough time for control, correcting common mistakes, and gradually mastering complex, compound movements. The exercises also emphasized correct body positioning, conserving effort, and optimizing time, which increased the player's mastery over the apparatus and enhanced body control and movement range. In this regard, Tofig stated: "A supportive learning tool reduces effort and saves time in achieving the goal, unlike traditional methods used with the control group."[8]

The researcher also notes that this age group tends to show improvements in physical characteristics such as muscle strength and overall strength-to-body weight ratio. Hara emphasized that "physical abilities at this age increase significantly, particularly speed and motor ability, although flexibility tends to decrease with age, requiring careful attention to this aspect."[9]

3.8.3 Presentation and Analysis of the Evaluation Results of the Backward Support Transition Movement for the Experimental and Control Groups

Table (13): Shows the median, interquartile deviation, and Wilcoxon values for the pre-test and post-test evaluations for the backward support transition movement.

Group	Test	Median	Interquartile Deviation	Calculated Wilcoxon Value	Tabulated Value	Sample Size	Significance

Experimental Group	Pre-test	4.5	1	0	5	9	Sig.
Control Group	Pre-test	6	1.75	6.5	5	9	No sig.

To test the significance of differences between the pre- and post-test evaluations for the research groups, the Wilcoxon signed-rank test was used. The results indicated significant differences in favor of the experimental group, with a calculated Wilcoxon value of **0**, smaller than the tabulated value of **5** at a **0.05** significance level with a sample size of **9**. The control group showed no significant differences, with a calculated Wilcoxon value of **6.5**, which is greater than the tabulated value of **5**.

Table 14. Demonstrates the significance of differences in the post-test results for the backward support transition movement using Mann-Whitney values.

Group	Variable	Median	Interquartile Deviation	Coefficient of Variation	Calculated (Y)	Tabulated (Y)	Significance
Experimental Group	Backward Support Transition	9	0.375	3.33	3.5	17	Significant
Control Group	Backward Support Transition	7.5	0.250	4.16			

The coefficient of variation for the control group was higher than that of the experimental group, indicating more variability and less improvement in the control group.

3.8.4 Discussion of the Evaluation Results of the Backward Support Transition Movement for the Experimental and Control Groups

The absence of significant differences in the pre- and post-test evaluations for the control group, as indicated in Table (14), is attributed to the lack of a comprehensive approach in the coach's standard program. The program did not fully address the physical preparation required for this movement, particularly in terms of speed-specific strength and motor capabilities like flexibility and agility, which are essential for performing this requirement. The researcher emphasizes that "the development of a gymnast's proficiency depends primarily on the integration of physical and motor capabilities."[10]

In contrast, the significant improvement in the experimental group is attributed to the impact of the proposed training program, which effectively developed the physical and motor capabilities necessary for parallel bar movements. The program contributed to significant improvements in the technical evaluation scores for the experimental group. The researcher also attributes the differences in post-test evaluations for the experimental group to the program's use of targeted exercises that improved overall performance, achieving the maximum possible score of **10 points** for both movements.[11]

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

Based on the results obtained from the field experiment and the appropriate statistical analyses, the following conclusions were reached:

1. The proposed training program had a positive effect on all physical and motor capability tests for the experimental group, as evidenced by significant differences between the pre- and post-tests.
2. Statistically significant differences were observed between the pre- and post-test evaluations for the experimental group in the scores for the parallel bars requirements, while no significant differences were found for the control group.
3. The proposed training program resulted in clear superiority for the experimental group in tests of explosive arm strength and flexibility compared to the control group.
4. The results confirmed the effectiveness of skill-based exercises in improving the technical performance of the forward and backward support transition movements on the parallel bars.

4.2 Recommendations

Based on the conclusions, the researcher recommends the following:

1. Focus on training specific muscle strength by enhancing the speed-specific strength of the arms and shoulders, as well as reaction speed and agility, to develop parallel bar requirements for students.
2. Emphasize the use of exercises that simulate skill-based movements related to the parallel bars and exercises that enhance specific strength and motor capabilities.
3. Ensure precise technical performance for all parallel bar movements under the supervision of the team coach to improve students' final scores.

4. Incorporate bodyweight exercises and equipment-based exercises that approximate one-third of the body weight to improve specific physical and motor capabilities.
5. Utilize skill-based exercises to develop physical and motor aspects effectively.
6. Use supportive learning tools when teaching the primary elements of the forward and backward support transition skills.

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