The effect of a proposed training program on developing some bio motor abilities and improving the performance of kinetic chain skills on the floor and parallel bars in artistic gymnastics for students

El efecto de un programa de entrenamiento propuesto en el desarrollo de algunas habilidades bio motoras y la mejora del rendimiento de las habilidades de cadena cinética en el suelo y las barras paralelas en gimnasia artística para estudiantes

Authors

Jumaah Mohammed Awadh [1]
Jasim Nafi Hummadi [2]
Nabhan Hameed Ahmed [3]
Wathiq Hasan Mubder [4]

[1] University of Anbar (Iraq)
[2] University of Anbar (Iraq)
[3] University of Almaarif (Iraq)
[4] University of Babylon (Iraq)

Corresponding author:
Jasim Nafi Hummadi
Jasim.n.hummadi@uoanbar.edu.iq

How to cite in APA

Awadh, J. M., Hummadi, J. N., Ahmed, N. H., Mubder, W. H., & Ali, O. A. (2025). The effect of a proposed training program on developing some bio motor abilities and improving the performance of kinetic chain skills on the floor and parallel bars in artistic gymnastics for students. *Retos*, *65*, 709–720. https://doi.org/10.47197/retos.v65.111069

Abstract

Introduction: The importance of the research lies in developing a proposed training program to raise the level of biomotor capabilities as they are closely related to the skill aspect. Objective: To identify the imrepact of the proposed and followed training programs in developing some biomotor abilities and improving the performance of kinetic chain skills on the ground and parallel movements in artistic gymnastics. Procedures: The experimental approach was used. The program included (20) training units for (10) weeks and two training units per week; after conducting the pre-tests and applying the training program, the post-tests were conducted, and information and data were collected for statistical analysis by the statistical bag. Results: The results of the pre-and post-tests of the biomotor abilities and kinetic chain skills of the experimental group showed that the value of the significance (sig.) is less than the significance level (= 0.05), and this means that there are significant differences between the results of the pre-and post-tests for the research sample and in favour of the post-tests. Discussion: The researchers attribute the improvement in the kinetic chain to the proposed training program, which in turn led to the development of biomotor abilities, which reflected positively on the kinetic chain among the members of the experimental research sample. Conclusions: The researchers concluded that the proposed and followed training programs had a clear positive impact on developing some biomotor abilities and improved kinetic chain skills on the ground and parallel movement systems.

Keywords

Training program; biokinetic abilities; kinetic chain; ground movements; parallel bars.

Resumen

Introducción: La importancia de la investigación radica en el desarrollo de una propuesta de programa de formación para elevar el nivel de las capacidades biomotoras ya que están estrechamente relacionadas con el aspecto de las habilidades. Objetivo: Identificar el impacto de los programas de entrenamiento propuestos y seguidos en el desarrollo de algunas habilidades bio motrices y la mejora del rendimiento de las habilidades de cadena cinética en el suelo y los movimientos paralelos en gimnasia artística. Procedimientos: Se utilizó el enfoque experimental. El programa incluyó (20) unidades de capacitación durante (10) semanas y dos unidades de capacitación por semana; Luego de realizar las pruebas previas y aplicar el programa de capacitación, se realizaron las pruebas posteriores y se recopiló información y datos para el análisis estadístico por parte de la bolsa estadística. Resultados: Los resultados de las pruebas previas y posteriores de las habilidades biomotoras y de la cadena cinética del grupo experimental mostraron que el valor de la significación (sig.) es menor que el nivel de significancia (= 0,05), lo que significa que existen diferencias significativas entre los resultados de las pruebas previas y posteriores para la muestra de investigación y a favor de las pruebas posteriores. Discusión: Los investigadores atribuyen la mejora en la cadena cinética al programa de entrenamiento propuesto, que a su vez condujo al desarrollo de habilidades biomotoras, lo que se reflejó positivamente en la cadena cinética entre los miembros de la muestra de investigación experimental. Conclusiones: Los investigadores concluyeron que los programas de entrenamiento propuestos y seguidos tuvieron un claro impacto positivo en el desarrollo de algunas habilidades biomotoras y en la mejora de las habilidades de la cadena cinética en el suelo y en los sistemas de movimiento paralelo.

Palabras clave

Programa de entrenamiento; habilidades biocinéticas; cadena cinética; movimientos del suelo; barras paralelas.

Introduction

Artistic gymnastics is one of the global sports that has received great attention in various international and Olympic championships due to the different equipment and diverse and exciting skills that characterise this sport, which has made it at the forefront of sports activities and one of the most important in the world(Safaa Ali AL-Attar & Shihab Jari, n.d.). This is clearly evident in the progress of the skill level that the players have reached as a result of this sport relying on applying scientific foundations and principles and standardising training programs appropriate for the players, in addition to developing new scientific methods that are compatible with innovating difficult skills(Leyton Román et al., 2015).

Gymnastics is one of the most important sports in physical education programs, and it works to satisfy the needs of students and suit their different age groups. It is like any other individual activity, as it works to provide the individual with skills that continue to be practised in the future, as it contributes greatly to the development of certain aspects of physical fitness and its development and advancement (Pei et al., 2023). Artistic gymnastics is an important and vital sport that requires various methods and approaches to improve its skills and advance the level of students' performance. It also contributes fundamentally to the development and advancement of motor and various skill capabilities among students because it depends on performing a series of interconnected movements(Freiré Maceiras et al., 2023). Therefore, the student must have good motor capabilities to be able to succeed in performing the required movement task, and any defect in these motor capabilities may prevent the achievement of goals(Safaa Ali AL-Attar & Shihab Jari, n.d.). This sport is also considered one of the most difficult artistic and aesthetic sports, and it requires the teacher to prepare the student physically, motorically, skillfully, and psychologically to practice it. "Reaching the required level of performance of motor sentences depends to a greater extent on physical qualities, which are considered the most important components and main elements in teaching and acquiring motor skills and successfully performing them well, as the ideal artistic gymnast is distinguished by the muscular strength of the shoulder, arms, abdomen and back area, and the muscular strength of the lower limb is also of great importance in performing ground movement skills, and the artistic gymnast is distinguished by a high level of agility, flexibility and muscular endurance" (Sriwahyuniati et al., 2023).

Biomotor variables are also one of the most important abilities of the technical gymnast, as they are "an important determinant in achieving sports excellence in most sports activities, and they contribute to the achievement of any physical effort, but the percentage of their contribution varies according to the type of performance, so they occupy a large space in sports training curricula(Mohammed, 2022).

Hence, the importance of the research in developing a proposed training program to raise the level of motor abilities, as they are closely related to the skill aspect, as it requires the student to acquire an appropriate amount of these abilities to reach a high level of performing the motor chain well, and this increases the student's ability to perform many skills on various artistic gymnastics devices.

Through the work of researchers in the College of Physical Education and Sports Sciences, University of Anbar, for the subject of artistic gymnastics, they noticed a decrease in the level of students' grades in the subject of artistic gymnastics compared to other subjects. This is due to the nature of artistic gymnastics and what it requires in terms of high biokinetic and skill capabilities, in addition to the fact that it requires training at an early age, as well as the researchers' knowledge of the shortcomings in skill preparation programs in general and biokinetic preparation programs in particular in artistic gymnastics for students, and the urgent need for the existence of these programs in their various forms in order to prepare students bio kinetically to perform the movement chain specific to the curriculum in the correct manner. Hence, the idea of the study came from developing a proposed training program to develop some biokinetic capabilities and improve the performance of the kinetic chain on the floor and parallel gymnastics devices for third-year students in the College of Physical Education and Sports Sciences, University of Anbar.

The research aims to:

1. Identify the effect of the proposed training program in developing some biokinetic abilities and improving the performance of kinetic chain skills on the floor and parallel gymnastics devices for the experimental research group.

2. Identify the effect of the following program in developing some biokinetic abilities and improving the performance of kinetic chain skills on the floor and parallel gymnastics devices for the control research group.
3. Identify the superiority of the two proposed and followed training programs in developing some biokinetic abilities and improving the performance of kinetic chain skills on the floor and parallel gymnastics devices for the experimental and control research groups.

Research hypotheses:

1. There are significant differences between the results of the pre-and post-tests of biokinetic abilities and kinetic chain skills on the floor and parallel gymnastics devices for the experimental research group.
2. There are significant differences between the results of the pre-and post-tests of biokinetic abilities and kinetic chain skills on the floor and parallel bars in artistic gymnastics for the control research group.
3. There are significant differences between the results of the post-tests of biokinetic abilities and kinetic chain skills on the floor and parallel bars in artistic gymnastics for the experimental and control research groups.

Method

Participants

The research community was represented by third-year students in the College of Physical Education and Sports Sciences / University of Anbar, numbering (82) students distributed into two sections. As for the research sample, it was selected randomly, represented by students of Section (B), numbering (40) students, constituting (39.02%) of the research community, where they were distributed into two experimental and control groups through odd and even numbers, each group consisting of (16) students, because four students had injuries that prevented them from performing, and two students were travelling. To ensure that the two groups were on the same starting line, the researchers conducted equivalence between the two groups in the dependent variables, where the researchers used the (T) test for independent samples of equal numbers, as in Table (1).

Table 1. Shows the equivalence results between the experimental and control groups.

no	Study variables	Unit of measure	Experimental group		Control group		Calculated value of (t)	Sig.	Significance level
			Arithmetic mean	standard deviation	Arithmetic mean	standard deviation			
1	Speed-specific strength of the arms	Repetition	8.7	1.83	8.75	1.33	Random	0.67	Random
2	Speed-specific strength of the legs	Repetition	13.45	1.60	13.6	1.18	Random	0.84	Random
3	Shoulder flexibility	cm	24.6	2.13	24.55	1.19	Random	0.58	Random
4	Trunk flexibility	cm	21.2	1.98	20.4	1.90	Random	0.89	Random
5	Agility	second	4.70	0.23	4.58	0.37	Random	0.77	Random
6	Kinetic chain on the floor exercise machine	degree	2.72	0.49	2.67	0.41	0.84	1.11	Random
7	The kinetic chain on the parallel bar	degree	2.14	0.37	2.16	0.33	0.42	1.32	Random

Table (t) value (2.042) at a degree of freedom (32-2=30) and a significance level (0.05).

From the table above, it is clear that the sample was distributed normally through the results of the dependent variable tests, as it was shown that the value of the significance (sig.) is greater than the significance level (α=0.05), which means that we accept the null hypothesis that there is no difference between the results of the pre-and post-tests of the research sample, which means that there is equivalence between the individuals of the two groups before starting to implement the program.

Procedure

Study Design

The researchers used the experimental method and designed two equivalent experimental and control groups with pre- and post-tests(Mohammed Hammood et al., 2025).

Instrument

Devices, tools, and means of collecting information

• Devices (stopwatch, Sony camera, digital calculator, Dell computer, floor exercises device, parallel bars).

• Tools (weights of different weights, dumbbells of different weights, laser discs, benches of different heights, 10 sticks, 10 markers, 10 sponge mats, powder).

• Information collection methods (tests and measures, data collection form, video recording, support team, performance evaluation form, expert and specialist opinion form).

Physical Activity Quiz

Tests used in the research

1. Pull-up test on the bar for (10) seconds (Hamza et al., 2021)
2. Sit-up, stand-up, and jump-up test for 30 seconds to measure the strength characterised by the speed of the legs(Ali et al., 2022).
3. Shoulder-raising test to measure shoulder flexibility (Cosma et al., 2014; Potop et al., 2018)
4. Trunk flexion test from a sitting position to measure trunk flexibility (Potop et al., 2018)
5. Running and quarter-turning test to the right to measure agility (Hassan et al., 2015)
6. The Kinetic chain test for the ground movement device (forward roll + diving ball + handstand and landing together + backward roll + Arabic jump).
7. Parallel bar kinetic chain test (lean on the bar + front-rear swing + standing on the shoulders + front roll down + sideways landing from the front swing).

Exploratory experiment

The exploratory experiment was conducted on a sample of (5) students from the same research sample, and they were not excluded from the experiment on Sunday (10/16/2022). The aim of the experiment was to ensure that the research sample understands and comprehends the tests used and how to perform them, Knows the adequacy of the support team, Ensure the accuracy of recording the results(Ali et al., 2024), Ensure that there are no obstacles that could affect the course of the experiment, Know the time required to implement the tests, Ensure that all devices and tools necessary to implement the tests are available.

Scientific coefficients of tests

The researchers adopted scientific foundations in the process of standardising the tests, although the components of these tests are standardised, to ensure the scientific nature of the tests by knowing their validity, reliability, and objectivity, as shown in Table (2).

Table 2. shows the validity and reliability coefficients of the study variables

no	Abilities	Honesty	Consistency	Objectivity
1	Speed Strength of Arms	%0.88	0.89	0.94
2	Speed Strength of Legs	%0.88	0.91	0.91
3	Shoulder Flexibility	%100	0.93	0.95
4	Trunk Flexibility	%100	0.88	0.97
5	Agility	%0.77	0.87	0.92
6	Kinetic Chain on Floor Exercises	%100	0.92	0.94
7	Kinetic Chain on Parallel Bars	%100	0.95	0.93

Field research procedures

Pre-test

The researchers conducted pre-tests for the experimental and control groups after conducting the exploratory experiment and verifying the validity and reliability of the tests. The tests were applied in the internal hall of artistic gymnastics in the College of Physical Education and Sports Sciences for two days. On Tuesday, corresponding to (10/18/2022) at exactly 10:30 in the morning, biokinetic abilities tests were conducted. On Wednesday, corresponding to (10/19/2022) at exactly 10:30 in the morning, kinetic chain tests were conducted for the floor and parallel motion devices, and the results were recorded in special forms. 2-7-2-The main research experiment

In order to ensure the achievement of the research objectives, the researchers prepared the proposed training program, and with the aim of verifying the validity of the scientific foundations followed in preparing the program and its suitability for the individuals of the research sample, the researchers sought the opinions of experts and specialists (see Appendix 1) by presenting it to them, to ensure the possibility of implementing the proposed training program and achieving the goals set by the researcher, and after taking into account the opinions of experts and specialists, the program was put in its final form, as the implementation of the proposed training program began on Sunday (10/23/2022) until Tuesday (12/27/2022), and the proposed program was implemented as follows:

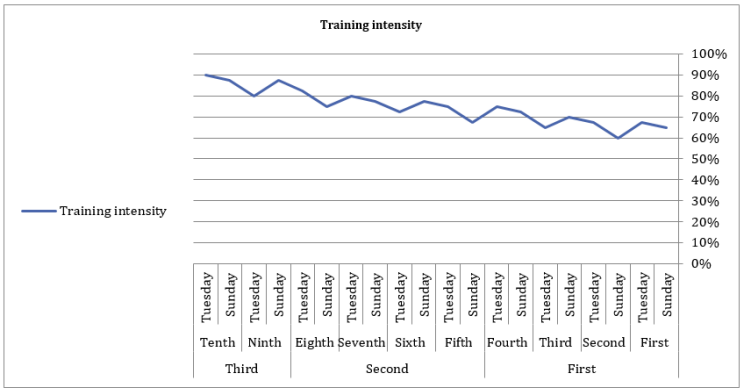
1. The program included (20) training units for a period of (10) weeks at a rate of two training units per week for (Sunday and Tuesday).
2. The duration of the training unit was (38-40) minutes, specifically in the main section.
3. The total number of exercises was (27), including (15) strength exercises, divided into three groups (1-2-3) and each group contains (5) exercises, and (6) flexibility exercises, divided into two groups (1-2) each group contains (3) exercises, and (6) agility exercises, divided into two groups (1-2) each group contains (3) exercises, divided into training units.
4. The exercises were implemented in the form of stations; each training unit contains (8) exercises. Every two students perform the first exercise, and after finishing, they move to the second exercise in a circular manner, and so on with the rest of the students until all the exercises are completed.
5. The principle of individual differences was considered as a basic factor in training to set the components of the training load.
6. The method of high-intensity and repetitive interval training was used.
7. Due to the nature of the sample individuals and the research objective, the appropriate intensity was determined and graded from (medium, above average, and below maximum) with intensities ranging between (60% - 90%) of the maximum intensity.
8. The appropriate intensity was determined by manipulating the number of repetitions, times, weights, length of distance, and rest between repetitions and sets.
9. The proposed training program included three training circuits (strength circuit, flexibility circuit, agility circuit).

Table 3. Shows the distribution of training circuits and intensities over the proposed training program period

Month	Week	Today	Circuit used	intensity
First Second Month First	First	Sunday	(Strength1 – Flexibility1)	%65
		Tuesday	(Strength2 – Agility1)	%67.5
	Second	Sunday	(Strength3 – Flexibility2)	%60
		Tuesday	(Strength1 – Agility2)	%67.5
	Third	Sunday	(Strength2 – Flexibility1)	%70
		Tuesday	(Strength3 – Agility1)	%65
	Fourth	Sunday	(Strength1 – Agility2)	%72.5
		Tuesday	(Strength2 – Agility2)	%75
Second Month First	Fifth	Sunday	(Strength3 – Flexibility1)	%67.5
		Tuesday	(Strength1 – Agility1)	%75
		Sunday	(Strength2 – Agility2)	%77.5

Second	Sixth	Tuesday	(Strength3 – Agility2)	%72.5
		Today	(Strength1 – Flexibility1)	%77.5
	Seventh	Sunday	(Strength2 – Agility1)	%80
		Tuesday	(Strength3 – Flexibility2)	%75
	Eighth	Sunday	(Strength1 – Agility1)	%82.5
Third	Ninth	Tuesday	(Strength2 – Agility1)	%87.5
		Sunday	(Strength3 – Flexibility2)	%80
		Tuesday	(Strength1 – Agility2)	%87.5
		Sunday	(Strength1 – Agility2)	%90

Figure 1. Shows the intensity of the training units during the duration of the program implementation



Post-test

After completing the main research experiment, the researchers conducted the post-tests for the experimental and control groups, considering the same temporal and spatial conditions, tools, devices, and auxiliary work teams that were used in the pre-tests. These tests were conducted over two days. On Wednesday (12/28/2022), the motor abilities tests were conducted, and on Thursday (12/29/2022), the kinetic chain tests were conducted for the ground and parallel motion devices.

Data analysis

The researchers relied on the SPSS statistical package program to process the results of their research by using the appropriate statistical treatments(Hammood et al., 2024; Saeed et al., 2024).

Results

Presentation of the pre-and post-tests of the study variables for the experimental group

Table 4. Shows the values of the arithmetic means, standard deviations, calculated t-test values (Sig.), and the significance of the differences for the pre-and post-tests for the experimental research group

no	Variables	Unit of measure	Pre-tests		Post-tests		Calculated T value	Sig.	Significance of differences
			Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation			
1	Speed-specific strength of the arms	Repetition	8.7	1.83	11.6	1.98	6.920	0.00	Moral
2	Speed-specific strength of the legs	Repetition	13.45	1.60	16.8	1.28	4.932	0.01	Moral
3	Shoulder flexibility	cm	24.6	2.13	30.05	1.84	8.816	0.00	Moral
4	Trunk flexibility	cm	21.2	1.98	28.45	2.39	5.452	0.00	Moral
5	Agility	second	4.70	0.23	3.71	0.32	8.361	0.02	Moral
6	Kinetic chain on the floor	degree	2.72	0.49	8.12	0.52	8.337	0.00	Moral
7	The kinetic chain on the parallel bars	degree	2.14	0.37	7.87	0.47	8.764	0.00	Moral

Presentation of the pre-and post-tests of the study variables for the control group

Table 5. Shows the values of the arithmetic means, standard deviations, calculated t-test values (Sig.), and the significance of the differences for the pre-and post-tests of the control research group.

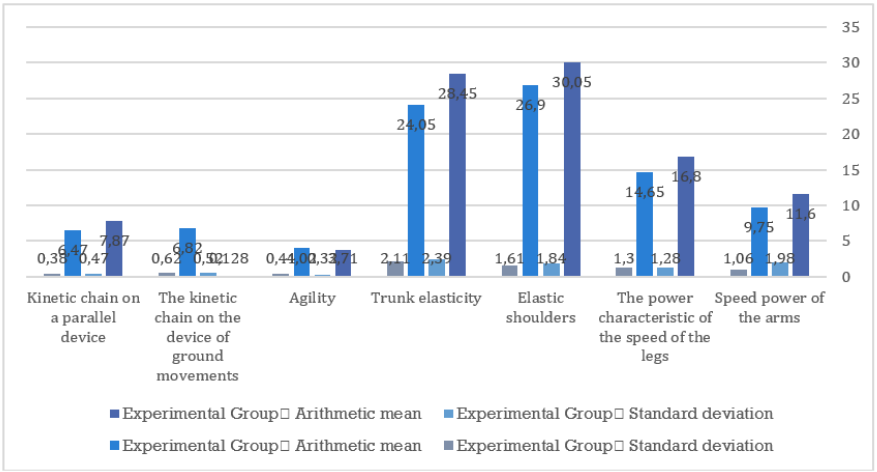
no	Variables	Unit of measure	Pre-tests		Post-tests		Calculated T value	Sig.	Significance of differences
			Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation			
1	Arm Speed Strength	repeat	8.75	1.33	9.75	1.06	3.196	0.00	Moral
2	Legs Speed Strength	repeat	13.6	1.18	14.65	1.30	3.693	0.02	Moral
3	Shoulder Flexibility	cm	24.55	1.19	26.9	1.61	3.012	0.00	Moral
4	Trunk Flexibility	cm	20.4	1.90	24.05	2.11	4.130	0.00	Moral
5	Agility	second	4.58	0.37	4.02	0.41	3.496	0.01	Moral
6	Floor Kinetic Chain	degree	2.67	0.41	6.82	0.62	5.622	0.02	Moral
7	Parallel Kinetic Chain	degree	2.16	0.33	6.47	0.38	5.250	0.03	Moral

Displaying and discussing the results of the post-tests of the study variables for the experimental and control groups

Table 6. Shows the values of the arithmetic means, standard deviations, calculated t-test values (Sig.), and the significance of the differences for the post-tests for the experimental and control research groups.

	Variables	Unit of measurement	Experimental Group		Control group		Calculated T value	Sig.	Significance of differences
			Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation			
1	Speed power of the arms	reiteration	11.6	1.98	9.75	1.06	3.670	0.00	Moral
2	The power characteristic of the speed of the legs	reiteration	16.8	1.28	14.65	1.30	2.808	0.03	Moral
3	Elastic shoulders	cm	30.05	1.84	26.9	1.61	3.912	0.01	Moral
4	Trunk elasticity	cm	28.45	2.39	24.05	2.11	3.360	0.01	Moral
5	Agility	cm	3.71	0.32	4.02	0.41	2.629	0.00	Moral
6	The kinetic chain on the device of ground movements	degree	8.12	0.52	6.82	0.62	5.990	0.00	Moral
7	Kinetic chain on a parallel device	degree	7.87	0.47	6.47	0.38	10.964	0.01	Moral

Figure 2. Shows the arithmetic means and standard deviations of the study variables.



Discussion

Discussion of the results of the pre-and post-tests of the study variables for the experimental group

It is noted from Table (4) for the results of the pre-and post-tests of the biomotor abilities and kinetic chain skills of the experimental group that the value of the significant significance (sig.) is less than the significance level (α=0.05), which means that we reject the null hypothesis and accept the alternative hypothesis that states that there are significant differences between the results of the pre-and post-tests

of the research sample in favour of the post-tests. We note from the table above that the significant differences that appeared in the arm tests are greater than the differences that appeared in the leg tests.

The researchers believe that the reason for this is that the skill performance on most artistic gymnastics devices depends more on the arms and shoulder belt, as the student must be distinguished by muscle strength in the arms, shoulders, abdomen, and back(Abd Ali & Abdel Reda, 2021). Also, "the artistic gymnast needs a large amount of strength of all kinds in all parts of the body, especially the shoulders, arms and trunk in order to achieve skill performance on most artistic gymnastics devices" (Vonnard & Mayencourt, 2024). As for flexibility, the results showed that there is a statistically significant positive effect on developing the level of shoulder and trunk flexibility among the members of the experimental group. The researchers attribute these differences to the nature of the exercises used in the proposed training program, part of which was allocated to flexibility exercises, in addition to the benefit of the sample members from performing resistance exercises with wide ranges that work to increase the flexibility of the body's joints, which was reinforced by *(*Pei et al., 2023b*)* "The use of weights, medical balls, tools, and weights doubles the efficiency of the exercises because they help double the range of motion in the joints." The results related to agility ability also showed that there is a statistically significant positive effect in developing the level of this ability among the members of the experimental group.

The researchers attribute this moral development to the proposed training program since the researchers set a special circle for agility exercises, in addition to developing muscular strength, which mainly affects agility. Also, "Increasing strength contributes significantly to increasing agility, as well as muscular strength, as it is an important element in the agility component" (Hassan et al., 2015).

The researchers attribute the improvement in the motor chain to the proposed training program, which in turn led to the development of bio motor abilities, which reflected positively on the motor chain among the members of the experimental research sample, as "the development of biomotor abilities is one of the most important reasons affecting the improvement of artistic gymnastics skills"(Daraa, 2024).

Regarding the effect of the proposed training program on Improving the performance of the kinetic chain skills of the ground and parallel motion devices. It was found that there was a significant positive effect of the proposed training program on this chain(Naser & Almali, 2023), The researchers believe that the reason for this is due to the development in biokinetic abilities because of the proposed training program, as "reaching the required level of performance of the kinetic chain depends to a greater extent on biokinetic abilities, which are considered the most important components and main elements in teaching and acquiring motor skills and successfully performing them well".

Discussing the results of the post-tests of the study variables for the experimental and control groups

It is noted from Table (6) for the results of the post-tests of the bio motor abilities and motor chain skills for the experimental and control research groups that the value of the significant significance (sig.) is less than the significance level (α=0.05), which means that we reject the null hypothesis and accept the alternative hypothesis that states that there are significant differences between the results of the post-tests for the experimental and control research groups in favour of the experimental group.

The researchers believe that this superiority that appeared in the post-tests of all study variables for the experimental research group was the result of the experimental group implementing the proposed and planned training program based on scientific foundations based on modern scientific sports training principles in developing biomotor abilities, as this program outperformed the followed program with limited positive effects that focuses on teaching and training motor skills without focusing on developing specific biomotor abilities, as "the increase in improvement in the abilities studied within the proposed training programs is due to standardised training according to the specific abilities of each player"(Costa et al., 2021).

The researchers believe that the diversity in the exercises used and the lack of use of a fixed method had a significant impact on the development of the biomotor abilities of the players, as "diversity in sports performance is one of the basic factors for the balancing process in physical integration, and works to increase the desire to train" (Abdul-Razzaq & Ibrahim, 2014).

The researchers believe that the existence of statistically significant differences between the two groups in the level of performance of the motor chain under study and in favor of the experimental group is due

to its subjection to the proposed training program that aims to develop the specific biomotor abilities associated with the motor skills that make up the motor chain under study, and this is what (Aydın et al., 2023) confirms that "the prior development of special physical and motor abilities is an urgent necessity to improve the learning process based on the close relationship between each of the skill performance and physical and motor abilities" .

Since the performance of the kinetic chain depends on the player himself, he must have a high level of general and specific biokinetic abilities, as "special physical preparation is an urgent necessity for developing and improving the performance of motor skills specific to the type of activity practised, as reaching the highest level of skill performance of movements requires the player to have many general and specific physical abilities, which helps him to raise the level of his skill performance on all artistic gymnastics devices" (Yuzela et al., 2023).

The researchers have been interested in the principle of gradation in the distribution of stress, training loads, and rest times between repetitions and groups by training units in a scientific and accurate manner, as(Juma & Jaber, 2023) indicate that "gradation to reach the best level of performance has become an important base of training, and that gradation means the conduct of the training plan in a way that is easy to difficult and from simple to complex".

Conclusions

1. The proposed training program had a clear positive effect in developing some biokinetic abilities, such as (the strength characterised by speed for both legs and arms, flexibility of the trunk, flexibility of the shoulders, and agility).

2. The proposed training program had a clear positive effect in improving the performance of kinetic chain skills on the floor and parallel bars.

3. Both the proposed and followed training programs led to the development of biomotor abilities and improved the performance of kinetic chain skills on the floor and parallel motion devices, but the proposed training program outperformed the following program by a large percentage.

4. The validity of the proposed training program in developing biomotor abilities and improving the performance of kinetic chain skills on the floor and parallel motion devices among students at the College of Physical Education and Sports Sciences at the University of Anbar.

In light of their conclusions, the authors recommend the following:

1. Disseminate the results of the current study to artistic gymnastics professors in Iraqi universities to benefit from them in preparing training programs

2. The proposed training program will be used to develop biomotor abilities and improve the performance of kinetic chain skills on the floor and parallel bars for students of the faculties of physical education and sports sciences in Iraqi universities.

3. Conducting studies similar to the current study on different biomotor and skill abilities.

4. Conducting studies similar to the current study on various other team and individual games.

5. Conducting studies similar to the current study on different age groups and for both genders

Acknowledgements

We extend our sincere thanks and appreciation to all the participating authors for their valuable intellectual and cognitive contributions that influenced this work.

Financing

No funding was received for this study.

References

Abd Ali, Z. S., & Abdel Reda, B. K. (2021). The Effect of Exercises with a Proposed Device to Improving Some Bio-Kinematic Variables and the Performance of the Arab Round off Skill on Floor Movement Mat Device of the Artistic Gymnastics for Women. *Indian Journal of Forensic Medicine & Toxicology*, *15*(3), 1292–1299. https://doi.org/10.37506/ijfmt.v15i3.15489

Abdul-Razzaq, A.-J., & Ibrahim, S. M. (2014). Effectiveness of Skilful Exercises on the Performance Level of Twisting Movements on the Carpet of Floor Exercises for Youth Gymnastic Players. *Al-Rafidain Journal of Sports Sciences*, *20*(66), 1–22.

Ali, O. A., Ahmed, W. H., Saeed Abd, A. Q., & Hummadi, J. N. (2022). Effect of a proposal of exercises on the development of basic motor abilities in men's artistic gymnastics. *Sport TK*, *11*. https://doi.org/10.6018/sportk.539131

Ali, O. A., Mushref, A. J., Hummadi, J. N., & Awad, A. (2024). The effect of a proposed training curriculum to develop some special physical abilities and the accuracy of the movement scoring skill for the Ramadi football club players | El efecto de un plan de estudios de entrenamiento propuesto para desarrollar algu. *Retos*, *61*, 193–200. https://doi.org/10.47197/retos.v61.107271

Aydın, E. M., Gündoğan, B., & Demirkan, E. (2023). How does artistic gymnastics and trampoline gymnastics training affect dynamic balance, abdominal strength, jump performance, and flexibility in adult females? *Acta Gymnica*, *53*. https://doi.org/10.5507/ag.2023.002

Cosma, A., Orţănescu, D., & Cosma, G. (2014). The Role of Gymnastics Elements in Training Junior Volleyball Players. *Procedia - Social and Behavioral Sciences*, *117*, 427–430. https://doi.org/10.1016/j.sbspro.2014.02.239

Costa, A. R., Lopes, M. J. A., Dias, A. P. D. S., & Cardozo, P. L. (2021). A influência parental na carreira de jovens atletas de Ginástica Artística (The parental influence on the career of young Artistic Gymnastics). *Retos*, *41*, 804–811. https://doi.org/10.47197/retos.v41i0.79362

Daraa, H. M. (2024). The Effect Of Parkour Exercises On Some Physical And Motor Abilities And Movement Performance In Artistic Gymnastics For Female Students. *Journal of the College of Basic Education*, 397–407.

Freiré Maceiras, R., Fernández Villarino, M., & Sierra Palmeiro, E. (2023). Componentes del rendimiento en gimnasia rítmica individual (Components of performance in individual rhythmic gymnastics). *Retos*, *49*, 16–21. https://doi.org/10.47197/retos.v49.97981

Hammood, Y. M., Awad, A. K., Ali, O. A., Mushref, A. J., & Hummadi, J. N. (2024). Measuring the aggressive behavior of the teams in the Iraqi Premier League in football and its relation to the results and ranking of the league for the 2022-2023 season. Sportske Nauke i Zdravlje, 14(2), 127–134. https://doi.org/10.7251/SSH2402127H

Hamza, M., Sekran, J., & Lafta, A. A. (2021). Motivation and Self – Confidence and their relation to Routine Performance on Parallel Bars in Men's Artistic Performance. *Journal of Physical Education*, *33*(2), 91–97. https://doi.org/10.37359/jope.v33(2)2021.1145

Hassan, H. S., Hanna, S. J., & Ameen, F. M. (2015). Effect of theoretical biomechanics on open jump the platform jumps performance using jumps (vault) in artistic gymnastics. *Journal of Human Sport and Exercise*, *10*(Proc2), S742–S746. https://doi.org/10.14198/jhse.2015.10.Proc2.15

Juma, S. K., & Jaber, W. F. (2023). The effect of CROSSFIT exercises on the development of biokinetic abilities and the level of performance of football referees for the first degree. *Al-Qadisiyah Journal of Physical Education Sciences*, *23*(2), 27–36.

Leyton Román, M., Luis del Campo, V., Sabido Solana, R., & Morenas Martín, J. (2015). Perfil y diferencias antropométricas y físicas de gimnastas de tecnificación de las modalidades de artística y rítmica (Anthropometric and physical differences of the gymnasts from the talent identification program of the artistic and rhythmic specialties. *Retos*, *21*, 58–62. https://doi.org/10.47197/retos.v0i21.34606

Mohammed Hammood, Y., Hussein Rashid, A., & Adham Ali, O. (2025). The effect of a proposed training method using play exercises to develop specific agility and skill performance in football | El efecto de un método de entrenamiento propuesto que utiliza ejercicios de juego para desarrollar la agilidad específica y el re. *Retos*, *63*, 719–728. https://doi.org/10.47197/retos.v63.111095

Mohammed, M. F. (2022). The impact of training curriculum to develop muscular strength and flexibility on some motor skills and the level of performance on the ground floor among young people . *Journal of Kirkuk University / Human Studies*, *17*(1), 305–325.

Naser, Dr. S. H., & Almali, Dr. W. A. H. (2023). The effect of skillful physical exercises on developing some biomotor abilities and skills (pump fake one dribble and shoot, pick repack and roll) for young basketball players. *International Journal of Yogic, Human Movement and Sports Sciences*, *8*(2), 326–331. https://doi.org/10.22271/yogic.2023.v8.i2e.1480

Pei, Y. A., Mahmoud, M. A., Baldwin, K., & Franklin, C. (2023a). Comparing Musculoskeletal Injuries across Dance and Gymnastics in Adolescent Females Presenting to Emergency Departments. *International Journal of Environmental Research and Public Health*, *20*(1). https://doi.org/10.3390/ijerph20010471

Pei, Y. A., Mahmoud, M. A., Baldwin, K., & Franklin, C. (2023b). Comparing Musculoskeletal Injuries across Dance and Gymnastics in Adolescent Females Presenting to Emergency Departments. *International Journal of Environmental Research and Public Health*, *20*(1). https://doi.org/10.3390/ijerph20010471

Potop, V., Creţu, M., Buftea, V., & Ulăreanu, M. V. (2018). Analysis of the specific physical training influence on the technical execution of double salto backward on the floor. *Journal of Physical Education and Sport*, *18*, 2186–2192. https://doi.org/10.7752/jpes.2018.s5330

Saeed, S., Sabti, Q., & Ali, O. (2024). Competitive Marketing Vigilance and its Relationship to Social Persuasion Among a Sample of Sports Equipment Sales Representatives in Iraq. *International Journal of Educational Evaluation and Policy Analysis*, *1*(4). https://doi.org/https://doi.org/10.62951/ijeepa.v1i4.48

Safaa Ali AL-Attar, L., & Shihab Jari, H. (n.d.). *THE EFFECT OF SPECIAL EXERCISES ACCORDING TO A DESIGNED DEVICE IN DEVELOPING THE PERFORMANCE OF A KINETIC CHAIN ON THE BALANCE BEAM DEVICE*.

Sriwahyuniati, C. F., Hidayatullah, M. F., Purnama, S. K., Siswantoyo, & Tomoliyus. (2023). Game-based rhythmic gymnastics exercise models to develop gross motor skills for primary school students. *Cakrawala Pendidikan*, *42*(1), 100–109. https://doi.org/10.21831/cp.v42i1.46027

Vonnard, P., & Mayencourt, G. (2024). Building European Fraternity Through Gymnastics: The Establishment of the Bureau Des Fédérations Européennes de Gymnastiques, 1863–1913. *International Journal of the History of Sport*. https://doi.org/10.1080/09523367.2024.2351219

Yuzela, A., Kristiyanto, A., & Riyadi, S. (2023). The Effect of Audio and Audio Visual Imagery Exercises on the Level of Creativity of Aerobic Gymnastics Instructors. *International Journal of Human Movement and Sports Sciences*, *11*(2), 292–298. https://doi.org/10.13189/saj.2023.110205

Authors' and translators' details:

Jumaah Mohammed Awadh	pe.dr.gmaa.mh@uoanbar.edu.iq	Author
Jasim Nafi Hummadi	Jasim.n.hummadi@uoanbar.edu.iq	Author
Nabhan Hameed Ahmed	nabhan.hameed@uoa.edu.iq	Author
Wathiq Hasan Mubder	phy684.wathiq.hasan@uobabylon.edu.iq	Author
Othman Aham Ali	othmanadhamali@uoanbar.edu.iq	Translator

Appendix 2. Shows the names of experts to determine the physicality, skill, and tests used in the research

	Scientific surname and name	Jurisdiction	Workplace
1	Prof. Laith Mohammed Hussein	Learning Animation - Artistic Gymnastics	College of Physical Education and Sports Sciences / University of Basrah
2	Assoc. Prof. Jamal Sakran Hamza	History - Artistic Gymnastics	College of Physical Education and Sports Sciences / University of Baghdad
3	Assoc. Prof. Anmar Atshan Kharkan	Athletic Training - Gymnastics Technician	College of Physical Education and Sports Sciences / University of Thi-Qar
4	Assoc. Prof. Kazem Issa Kazem	Athletic Training - Gymnastics Technician	College of Physical Education and Sports Sciences / University of Basrah
5	Dr. Oras Qasim Mohammed	Athletic Training - Gymnastics Technician	College of Physical Education and Sports Sciences / Anbar University

Appendix 2. Sample training module

Week: First Venue: Number of Students: (16) Students Unit Objective: Develop strength with speed and flexibility Used tools: iron appliances - wooden sticks - box	Week: First Module: First Day & Date: Sunday (23/10/2022) The duration of the proposed training program: (38 - 40) minutes

Section	no	Exercise	Repetitions	Time of performance	Sets	Rest between repetitions	Rest between sets	Total exercise time
Main	1	Pull the pulley back in front of you from a sitting position on the machine	2 × 10	12sec	2	30 sec	40 sec	6:16m
	2	From a standing position, open your arms back with the help of a partner	2 × 10	15sec	2	20 sec	30 sec	5:20m
	3	Bend the knees backwards from a prone position in front of the machine	2 × 8	10 sec	2	30 sec	40 sec	6:00m
	4	From a standing position, open your torso rotation to the sides	2 × 10	15 sec	1	20 sec	30 sec	2:40m
	5	Extend the knees from a sitting position on the weight machine	2 × 8	10 sec	2	20 sec	40sec	5:20m
	6	From a standing position, open your arms rotation backwards while holding the stick	2 × 10	15 sec	2	20 sec	30sec	5:20m
	7	Pen press in the middle of a level from a lying position on the machine	2 × 10	15 sec	2	20 sec	40sec	6:00M
	8	Climb onto a box and jump high	2 × 8	15 sec	1	20 sec	40sec	3:00m
total								39:56m