

The Effect of a Training Programon on Developing Pelvic and Shoulder Flexibility Among Female Gymnastics Students at The Faculty of Sports Science at Mutah University in Jordan

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Mutah University/ Faculty of Sports Science/ Department of Physical Education The Hashemite Kingdom of Jordan أثربرنامج تدريبي على تنمية مرونة الحوض والكتفين لدى طالبات مساق الجمباز في كلية علوم الرياضة في جامعة مؤتة

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المستخلص:

هدفت هذه الدراسة إلى فحص تأثير برنامج تدريبي على تنمية مرونة الحوض والكتفين لدى طالبات الجمباز في كلية علوم الرياضة بجامعة مؤتة في الأردن. استخدم الباحث المنهج التجريبي، وتكونت عينة الدراسة من ٣٠ طالبة، تم تقسيمهن إلى مجموعتين متساويتين (تجريبية وضابطة). ولتحقيق أهداف الدراسة، تم تصميم برنامج تدريبي يهدف إلى تطوير مرونة الكتفين والحوض، حيث اشتمل على ٢٠ وحدة تدريبية تم تنفيذها على المجموعة التجريبية على مدار ٥ أسابيع. تم إجراء اختبارات المرونة قبل وبعد تنفيذ البرنامج التدريبي، ثم تم جمع البيانات وتحليلها باستخدام اختبار مان-ويتني، وحُسب حجم التأثير باستخدام مربع إيتا. أظهرت النتائج تحسنًا دالًا إحصائيًا في مرونة الكتفين والحوض لدى طالبات الجمباز في الجامعة، كما أشارت قيم مربع إيتا إلى حجم تأثير كبير للبرنامج التدريبي في تنمية مرونة الحوض والكتفين. وأوصى الباحث باستخدام تمارين دقيقة ومتسلسلة ومستمرة لتطوير مرونة الحوض والكتفين لجميع لاعبات الجمباز، للحفاظ على مستوى عالٍ من الأداء الحركي في مختلف مهارات الجمباز.

الكلمات المفتاحية: برنامج تدريبي ، مرونة الحوض والكتفين، مساق الجمباز، كلية علوم الرياضة جامعة مؤتة.

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ABSTRACT

This study aimed to examine the impact of a training program on developing pelvic and shoulder flexibility among female gymnastics students at the Faculty of Sports Science at Mutah University in Jordan. The researcher used an experimental approach, the study sample consisted of 30 students, divided into two equal groups (experimental and control). To achieve the study's objectives, a training program was designed to develop shoulder and pelvic flexibility, which included 16 training units delivered to the experimental group over 5 weeks. Flexibility tests were conducted before and after the implementation of the training program. Afterward, the data were collected and analyzed using the Mann-Whitney test, and the effect size was calculated using eta-squared. The results showed a statistically significant improvement in shoulder and pelvic flexibility among the gymnastics students at the university. The eta-squared values indicated a large effect size of the training program in developing pelvic and shoulder flexibility. The researcher recommended using precise, sequential, and continuous exercises to develop pelvic and shoulder flexibility for all gymnasts in order to maintain a high level of motor performance across all gymnastic skills.

Keywords: Training program, pelvic and shoulder flexibility, female gymnasts, Faculty of Sports Science, Mutah University.



Introduction

Gymnastics is a sport with high aesthetic value in large-scale sports, and gymnastics courses in colleges and universities can promote the healthy development of college students. Flexibility training is one of the Targets of physical quality training in gymnastics (Aftimichuk, 2020). In gymnastics teaching in colleges and universities, enhancing athletes' flexibility training is an imperative requirement to improve athletes' gymnastics level, and practicing flexibility training in gymnastics teaching in colleges and universities is an important measure to reduce the possibility of athletes' sports injuries (Liang, 2020). Flexibility enables the body's joints to move and stretch in different directions (Kyranoudis, et, al., 2019), as well as soft tissues such as muscles and ligaments (Yi, 2017). It can be seen that athletes' flexibility is closely related to the range of motion of their joints, the suppleness of their muscles, ligaments and other soft tissues (Souza, et, al., 2017). The fact that flexibility is an essential element of fitness in gymnastics skills is not only because many of the technical elements that gymnasts must implement in their routines are essentially flexibility movements, but also because it is essential in performing a large number of tasks required in motor performance (Vernetta, et, al., 2017). Flexibility is a key factor in physical fitness, along with muscle strength and body stability. Flexibility reduces the risk of injury during training, and increases motor performance during daily activities, or sports/competitive activities s (Motahari-Tabari 2017). Restricted flexibility can be prevented through physical activities that increase range of motion (ROM), create better tissue tolerance for stretching, and reduce joint and spine pain (Micheo, Baerga, & Miranda, 2012).

College gymnasts are not professional gymnasts, and they have great differences in movement performance, especially in the basis of gymnastics, training environment, diet, and other physical conditions (Micheo, et, al., 2012), (Moncanu, G & Dobrescu, T. 2021). Therefore, coaches should provide flexibility exercises for athletes when training in a gradual and not impulsive manner. The coach should strictly enforce the students to continue training and lay a good foundation according to the established training according to the approved training plan, especially at the beginning of training. At the same time, during the training period, the coach should cultivate the athletes' character to train hard (Liang, 2020).

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According to the characteristics of gymnastics (Yi, 2017), the coach should strengthen flexibility training in the training process, try to combine flexibility training with strength training, and provide training for college students with moderate intensity. The flexibility training content should be arranged according to the physical level categories of the trainees and cheerleading (Masliak, et, al., 2019), (Nogueira, et, al., 2019) put differently, the coach should not train all gymnasts with the same training content and method but should provide training sessions according to the specific requirements of gymnastics with their physical capabilities, to avoid sports injuries. As solutions to improve resilience, (Moncanu, G & Dobrescu, T. 2021) recommends increasing the number of physical education classes in university curricula and making younger generations aware of the need to practice flexibility-related exercises during leisure time activities as ways to ensure a state of well-being and achieve good physical fitness. The significance of the study

All elements of physical fitness clearly contribute to the performance of various gymnastics skills, and flexibility is the most important of these elements in the motor performance of floor movements and apparatus gymnastics. Many studies (Wardani, et al., 2022) have indicated the degree of flexibility's contribution to mastering gymnastics skills, especially the flexibility of the pelvis and shoulders. Fjerstad, et al., (2018), states flexibility is considered the most prominent element in performing rotations and various swings, and floor mat skills. A study by AndriiChuk, et al., 2021 indicated the possibility of developing this skill, especially at an early age, and suggested different exercises and various training to increase it (Matsuo, et al., 2019). Through the researcher's work with gymnastics students, she noticed that they did not have a sufficient degree of flexibility, and that all other skills were affected and difficult to perform this may be attributed to the fact that at a high proficiency level due to the lack of sufficient flexibility in the pelvis and shoulder areas, this may be attributed to the fact that students did not receive training at an early age on gymnastics skills or strengthen the flexibility element, so the importance of this study emerged, in building and designing a program to develop the level of resilience, and examining its impact on female students.

Study objectives:

The study aimed at building and designing a training program to develop the flexibility of the pelvis and shoulders among female gymnastics students at the university, examine its impact on female gymnastics students at the Faculty of Sports Science at Mutah University.

Study Problem:

Through the researcher's work in training and teaching female gymnastics students at Mutah University, she noticed the difference in the students' level of flexibility of the pelvis and shoulders, and she also noticed that some skills are affected by the low level of flexibility, such as balance, speed, and reaction speed, and the low level of flexibility affects the mastery of performing most different gymnastics movements, as these skills depend mainly on flexibility. As such, so the researcher sought to build and design a training program that contributes to raising the level of flexibility of the pelvis and shoulders and examining its effect on the students, I it is worth noting that the flexibility of the pelvis and shoulders contributes mainly to mastering most gymnastics skills related to devices, tools and ground movements (Batista, et al., 2019), (Wardani, et al., 2022). Therefore, the problem of this study emerged as examining the effect of a training program on developing flexibility of the pelvis and shoulders among female gymnastics students in the College of Physical Education.

Study questions:

- 1- What is the effect of a training program on developing pelvic flexibility among female gymnastics students in the Faculty of Sports Science at Mutah University?
- 2- What is the effect of a training program on developing shoulder flexibility among female gymnastics students in the Faculty of Sports Science at Mutah University?

Study hypotheses:

- There is a statistically significant difference at the significance level ($\alpha \leq 0.05$) for the training program in developing pelvic flexibility among female gymnastics students in the Faculty of Sports Science at Mutah University.

- There is a statistically significant difference at the significance level ($\alpha \le 0.05$) for the training program in developing shoulder flexibility among female gymnastics students in the Faculty of Sports Science at Mutah University.







Study limitations:

The study was conducted on female gymnastics students at the Faculty of Sports Science at Mutah University in Jordan. The study was conducted in the academic year 2024.

Methodology:

The quasi-experimental method was used according to the requirements of the design of this study, as the design of this study was based on one experimental and one control group, and two pre- and post-measurements of the tests used.

Study Population and sample:

The study population entailed all students registered in gymnastics courses at the Faculty of Sports Science at Mutah University in Jordan. The study sample consisted of (30) female students, divided into two equal groups according to their scores in the study tests. The training program was delivered to the experimental group, while the control group was not given any training from within the training program.

Training program:

The training program comprised (16) training sessions related to flexibility, including (6) sessions to develop pelvic flexibility, and (6) sessions to develop shoulder flexibility. Each session lasted (40 minutes). The program continued for (5) weeks. The first session included an introduction and an explanation of the significance of the study and its objectives. The second session included applying tests to the entire study sample for the purpose of dividing the sample into two equal groups. Sessions (3-8) were related to exercises, training, and activities to develop pelvic flexibility. Sessions (9-14) were related to applying special training and activities to develop shoulder flexibility.

In each session, a 5-minute warm-up is performed (Zmijewski, et, al., 2020), and each exercise is explained and applied for no more than 3 minutes. In the main part of each session, which includes 8-10 exercises or activities, the focus is on the required joints, including the shoulders, or pelvis.

The training is based on simple and effective activities and tasks, well-known or easy to learn, in different positions of standing, sitting, lying on the stomach, lying on the back, hanging, and using accessible materials/devices, such as resistance bands, mattresses, Swedish ladders, and exercise balls. Examples of exercises used to improve flexibility include being in a hanging position with the back supported by the Swedish ladder, lateral body balance or back

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extension with knees bent and the soles of the feet on the floor; raising the arms and legs simultaneously or diagonally in a supine position; raising the pelvis in a supine position with the feet on an exercise ball; raising the arms forward or up sideways with the palms of the hands holding the resistance band; lateral flexions of the pelvis with free arching or using objects; counter-rotation of the pelvis, and throwing the ball against the wall; Back extension in a standing position facing the Swedish ladder by bending the trunk forward and gradually lowering the palms of the hands from one step to another; pulling the bent elbow back using the other arm; and twisting the trunk and extending the back in a standing position with the palms of the hands holding the back of the pelvis (Physique Engineer, 2019). The training also included some activities and floor exercises with the presence of a mattress.

In some sessions, choreography skills activities were used to increase the motivation of the participants, break the training routine, and enjoy the training program sessions (simple flexion Demi-Plie, deep flexion Grand-Plie, jumping with the feet open in the second position Echappee) (Anshela, M. & Marisi, D., 2013). Aerobic exercises were also used to improve oxygen perfusion, so that the body is pushed to improve the devices responsible for transporting oxygen (MacKay-Lyonsk, et, al., 2020), for the sake of comprehensive physical fitness to maintain a good physical level, as it works to harmonize the muscles through gradual stages of preparation (Yan, 2019) (Cooper, 2018), as its performance requires an increase in the amount of oxygen entering the body and causes positive changes in the circulatory and respiratory systems, and supplies the muscles with enzymes that help burn and get rid of excess fat (Jia & Li, 2020). It improves sleep habits, and helps reduce stress, fatigue, anxiety, and depression, and improves mood, as it reduces the degree of depression in those who practice it within a short period, and the mood changes from the first direct training dose (Tkachova, et, al., 2020). The penultimate session included applying flexibility tests for the shoulders and pelvis to the entire study sample for the purpose of comparing the two groups to extract the results. The last session included a final evaluation and thanking the students participating in the study.

Flexibility Tests

Some previous studies were reviewed on tests used to measure shoulder and pelvis flexibility, such as the study (Vernetta, et al., 2022), which worked to limit the tests used by previous studies (Mazo,



2010), (Batista, et, al., 2019), (Sleeper, et, al., 2012) and the following tests were used in the current study.

Pelvic flexibility tests:

- lower back: Sit-and-reach test (Mazo, 2010).
- Leg up with help of the hand: forward sideways and backward (Batista, et, al., 2019).

Shoulders flexibility tests:

- Shoulder rotation (Batista, et, al., 2019).
- The Shoulder Flexibility Test (Sleeper, et, al., 2012).

Validity and reliability: The tests were presented to (4) expert Jury members in gymnastics, and faculty members at Jordanian universities, and they were asked to submit their suggestions on the validity of these tests to measure the flexibility of the pelvis and shoulders. Then they were applied twice with a time difference of (10) days on a pilot sample of (15) female students from the study population, and the correlation coefficient between the two applications was calculated to extract the reliability of the repetition (Test. Retest) and compute the correlated indicators (Spilt- half) (Guttman), and they were all more than (0.78), which indicates a high degree of reliability for using the study tests, and Table (1) shows the reliability results.

Table (1)

Tests)Test.R test()Spilt- half(Guttman
lower back, Sit-and-reach	0.852	0.835	0.780
Leg up with help of the hand:	0.881	0.866	0.812
forward sideways and backward			
Shoulder rotation	0.890	0.882	0.837
The Shoulder Flexibility Test	0.906	0.914	0.883

The results of the reliability (Guttman) (Split-half) and (Test. Rtest)

Equivalents of groups: In order to divide the study sample into two equal groups, tests for flexibility of the pelvis and shoulders were applied before applying the training program. The study sample was arranged in descending order according to the performance scores in all tests, and the even numbers were chosen as an experimental group, and the odd numbers were a control group to ensure the equivalent of the two groups before application on flexibility skills of the pelvis and shoulders.



The differences between the two groups were calculated using the Mann-Whitney test to verify their equivalence in the experimental input, as shown in the following table:

Table (1): Means and Standard Deviations of the Experimental and Control Groups in the Pre-Test for the Study Variables

Group	exper	rimental		Contro l			Total		
Pelvis: lower back Sit-		Std.			Std.			Std.	
and_reach	Mean	Deviatio	Ν	Mean	Deviatio	Ν	Mean	Deviatio	Ν
and-reach		n			n			n	
Leg up with help of the									
hand: forward sideways and backward	5.0667	0.70373	15	5.2	1.01419	15	5.1333	80.86037	30
Shoulder rotation	5.4	1.18322	15	5.6	1.12122	15	5.5	1.13715	30
The Shoulder Flexibility Test	5.0667	0.88372	15	5.1333	0.83381	15	5.1	0.84486	30
	4.7333	30.59362	15	5.0667	0.79881	15	4.9	0.71197	30

It is clear from Table (1) that the means of the experimental and control groups in all variables are similar, and the differences between them are minimal. To ensure that these differences are not statistically significant, the Mann-Whitney test was used to calculate the significance of these differences, as shown in the following table:

Table (2): Results of the Mann-Whitney Test for Calculating the Difference Between the Ranks of Scores for the Experimental and Control Groups in the Pre-Test for the Study Variables

variables	group	Ν	Mean Rank	Sum of Ranks	u	sin	
Pelvis: lower back	experimen tal	15	15.40	231.00		Significant at the 0.05	
Sit-and-reach	Control	15	15.60	234.00	, , , ,		
	Total	30				level	
Leg up with help of the hand: forward	f experimen tal	15	14.73	221.00		Significant at the 0.05	
sideways and	Control	15	16.27	244.00	, • ,		
backward	Total	30				level	
	experimen tal	15	15.13	227.00		Significant at the 0.05 level	
Shoulder rotation	Control	15	15.87	238.00) • Y		
	Total	30					
The Shoulder Flexibility Test	experimen tal	15	13.87	208.00		Significant	
	Control	15	17.13	257.00		at the 0.05	
	Total	30				level	
		—[624				

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Table (2) indicates that all values of (u) are statistically non-significant at the 0.05 level, which suggests the equivalence of the two groups in the experimental inputs before applying the program.

Data collection: In order to implement the study, it was announced that the researcher wanted to conduct a study related to the development of the flexibility element among female gymnastics students. Anyone who wished to participate had the initiative to register his name with the researcher within a period of three days. After identifying the female students who wished to participate in the study, flexibility tests for the pelvis and shoulder were applied before implementing the training program. All participants in the study, monitor their scores for each test and the total, select (30) female students and then divide them into two equal groups (experimental & control) according to their performance scores on the premeasurements. Then, the training program sessions were provided to the experimental group only, and after completing the application of the training program, the same tests were conducted on the entire sample, and comparisons were made between the two groups to extract the results, answer the study questions, and test the hypotheses.

Statistical Analysis: The Mann-Whitney test was used to calculate the difference between the rank scores of the experimental and control groups in the post-test, due to the lack of conditions for using parametric tests, which is related to the sample size on which the program and tests were applied. This was done after confirming that there was no significant difference in the pre-test measurements between the two groups.

The results and discussion: The results of the study were presented based on the following questions:

Results of the first question: What is the effect of a training program on developing pelvic flexibility among female gymnastics students at the College of Sports Science at Mutah University in Jordan?

To answer this question, the Mann-Whitney (u) was applied to detect differences in the post-measurement in the presence of the premeasurement along with it. The results indicated that there is an effect for training programme on pelvic flexibility, whenever u. value for Sitand-reach test reached (8.5) (p=0.00), and u. value for Leg up with help of the hand: forward sideways and backward test reached (0)



(p=0.00). also, there are equivalents between two groups on pre-tests because u. values significant at level ($\alpha \le 0.05$), table (2) shows that. **Table 3**

variables	Group	Ν	Iean Ran	um of Rank	и	sin	
Pelvis: lower back Sit-and-reach	lxperimenta	15	22.43	336.50		1	
	Control	15	8.57	128.50	8.5	he 0.05 leve	
	Total	30					
Leg up with help of xperimenta		15	23.00	345.00			
the hand: forward	Control	15	8.00	120.00	00	Significant a	
sideways and backward	Total	30			00	he 0.05 leve	

Results of analysis of man witny (u) for pelvic flexibility tests

To determine the effect size of the training program in developing pelvic flexibility, the eta-squared (η^2) test was used, as shown in the results of the following table:

Table (4): Means and Standard Deviations of the Groups and Eta-Squared Values for Calculating the Effect Size of the Training Program on Pelvic Flexibility

Group		experimental			Control			
		N	Std	Me	N	Std	η2	
		IN Stu.	an	IN	Siu.			
Pelvis: lower back Sit-and-reach		1	0.915	5.2	1	1.146	0.64	
		5	48		5	42		
Leg up with help of the hand: forward sideways and backward		1	0.723	10	1	0.414	0.90	
		5	75	4.8	5	04	6	

It is clear from the previous table that the eta-squared values indicate a large effect size of the independent variable (the training program) on the dependent variables measuring pelvic flexibility, whether through the Pelvis: Lower Back Sit-and-Reach test or the Leg Up with Help of the Hand: Forward, Sideways, and Backward test, according to the effect size calculation indicators. Therefore, the training program has a significant effect on pelvic flexibility. Based on the previous result, the first hypothesis of the study is accepted.

It is worth noting that the exercises used during the training program sessions, which included raising the pelvis in a supine position with the feet on an exercise ball; raising the arms forward or up sideways with the palms of the hands holding the resistance band; lateral flexions of the pelvis with free arching or using objects; counter-rotation of the pelvis, and throwing the ball against the wall;

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Back extension in a standing position facing the Swedish ladder by bending the trunk forward and gradually lowering the palms of the hands from one step to another; pulling the bent elbow back using the other arm; and twisting the trunk and extending the back in a standing position with the palms of the hands holding the back of the pelvis; contributed to improving the level of flexibility of the trunk among the students. Many studies have indicated the ability of these activities to improve the level of flexibility, such as the studies of (Micheo, et, al., 2012), (Batista, et, al., 2019) they shewed examples of exercises used to improve flexibility which includes being in a hanging position with the back supported by the Swedish ladder, lateral body balance or back extension with knees bent and the soles of the feet on the floor, raising the arms and legs simultaneously or diagonally in a supine position and (Physique Engineer, 2019), (Liang, 2020).

Results of the second question: What is the effect of a training program on developing shoulder flexibility among female gymnastics students at the College of Sports Science at Mu'tah University in Jordan?

To answer this question, Mann-Whitney (u) was applied to detect differences in the post-measurement in the presence of the premeasurement along with it. The results indicate to there are effect for training programme on shoulder flexibility, whenever u. value between experimental and control groups for shoulder rotation test reached (12) (p=0.00), and u. value for the shoulder flexibility test reached (5) (p=0.00). also, there are equivalents between two groups on pre-tests because u. values not significant at level ($\alpha \le 0.05$), table (°) shows that.

Table 5:

Results of Mann-Whitney (u) for shoulders flexibility tests

Variable	Group	Ν	∕lean Ranl	um of Rank	u	Sign.	
Shoulder rotation	xperimenta	15	22.20	333.00		li ani Ciananta	
	Control	15	8.80	132.00	۲۱	he 0.05 leve	
	Total	30					
The Shoulder Flexibility Test	xperimenta	15	22.67	340.00		Significant a	
	Control	15	8.33	125.00	٥		
	Total	30				lie 0.05 leve	

To determine the effect size of the training program in developing shoulder flexibility, the eta-squared (η^2) test was used, as shown in the results of the following table:



Table 6: Means and Standard Deviations of the Groups and Eta-Squared Values for Calculating the Effect Size of the Training Program on Shoulder Flexibility

	Experimental			Control			
group	Mean	Ν	Std. D	Mean	Ν	Std. D	η2
Shoulder rotation	8.0667	15	0.79881	5.5333	15	1.30201	0.569
The Shoulder Flexibility	7.9333	15	0.79881	5.3333	15	0.97590	
Test							0.695

It is clear from the previous table that the eta-squared values indicate a large effect size of the independent variable (the training program) on the dependent variable (shoulder flexibility). The etasquared values indicate a significant effect size according to the interpretation rate of these values. Based on this result, the second hypothesis of the study is accepted

The researcher attributes the noticeable improvement in the level of shoulder flexibility to the activities provided and the precise exercises that were applied sequentially during the sessions of the training program dedicated to developing shoulder flexibility; using accessible materials/devices, such as resistance bands, mattresses, Swedish ladders, and exercise balls.; (Physique Engineer, 2019). These results agree with (Matsuo, et, al., 2019) and (Liang, 2020) (Batista, et, al. 2019) studies. The researcher also worked on designing groups within the experimental group to facilitate the process of applying the content of the sessions, and to achieve positive competition between the members of the experimental group during the performance of the training program sessions, in addition to the element of suspense and increasing motivation to interact with the activities of the training program.

Conclusion:

The flexibility of the torso and shoulders is considered one of the important and essential skills for performing various gymnastics skills. It serves as an indicator of the efficiency and development of performance. Therefore, the researcher designed and implemented a program aimed at improving flexibility levels and tested its impact among female university students with two groups. Data were collected through four flexibility tests related to the shoulders and pelvis, applied before and after the implementation of the training program. The Mann-Whitney test (u) was used to detect differences in the post-test measurements.





The results showed a statistically significant effect at the significance level ($\alpha \le 0.05$) of the program on improving the level of pelvic and shoulder flexibility among the students, with the experimental group outperforming the control group in the four flexibility tests. The eta-squared test results revealed that the effect size of this program was large. Based on the findings, the researcher recommended the use of appropriate, sequential, and non-intensive flexibility training for female university students, using well-structured and carefully designed programs based on practical experimental testing to develop pelvic and shoulder flexibility skills. Additionally, attention should be given to periodically assessing flexibility indicators, agility, and other elements of physical fitness among the students to ensure their suitability for performing various gymnastics skills and enhancing performance efficiency.

There is still a need for more studies to design flexibility development programs on larger samples and to use other tests, with the aim of confirming the prediction of the impact of regular training on developing shoulder and pelvic flexibility.

Recommendations

Based on the results obtained, the study recommends the following:

- It is necessary to pay attention to the element of flexibility, especially for the pelvis and shoulders, in improving the level of motor performance of female gymnastics students.

- Using precise, sequential and continuous exercises to develop the flexibility of the pelvis and shoulders for all gymnasts to maintain an advanced level of motor performance for all gymnastics skills.

- Using standardized and special tests to determine students' levels of flexibility, such as: lower back, Sit-and-reach. Leg up with help of the hand: forward sideways and backward. Shoulder rotation and the shoulder flexibility Test.

- Conducting extensive studies on all elements of physical fitness, and ensuring that female students are competent in performing the motor skills necessary for mastery.

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