



THE EFFECT OF PILATES TRAINING ON DEVELOPING SOME PHYSICAL ABILITIES AND PERFORMANCE LEVELS IN JAVELIN THROWING AMONG MIDDLE SCHOOL FEMALE STUDENTS

Assistant Professor Dr. Zainb Johni Gotee
Baghdad Al-Rusafa First Directorate of Education
Al-Shaab Secondary School for Girls
amzynbj@gmail.com

Abstract

This research study, then, aims to prepare Pilates exercises and find out their influence on developing some physical abilities. Diverse and modern methods that bring improvement in javelin throwing of middle school girl students are the research problem. Some physical abilities and the level of performance in javelin throwing among middle school girls is significantly correlated. The results of this analysis, as well as the statistical processing of the researcher sample data, led to a series of conclusions. The research sample is 4th year of preparatory school female students of Al-Shaab Preparatory School for Girls for the year 2025-2026. Research Methodology The researcher of the study chose Experimental Method with two samples one – control group and one – experimental group using pretest and post-test. The exploratory experiment was conducted by the researcher on a group of female students after pre-tests. Once the Pilates exercises were carried out, post-tests were held under a similar condition. The statistical processing of the results was done using the SPSS program using arithmetic mean, standard deviation, skewness coefficient, regression coefficient as well as correlation relationships of linked samples. Then, the researcher reached the conclusions that there is a direct relationship between the Pilates training with some physical abilities and the level of



performance in throwing the javelin among middle school students. This means that it has a positive effect in developing the physical abilities and improving performance in throwing javelin. The differences between the pre and post-tests of the research sample in some physical abilities are statistically significant in favor of the post-test in the group using Pilates training. Suggestions: Pilates training can be helpful.

It can be utilized in differing throwing activities and different stages, and in individual and group activities for all ages and both sexes.

Keywords: Pilates training, abilities, javelin throw.

Introduction

Improving the level of performance continues to be a major concern. Choosing the right training technique is one of the essential factors contributing to the success of the training process. Among contemporary workout methodologies, Pilates exercises are taking off which consist of device training exercises, aimed to strengthen the muscle groups, improve flexibility and enhance muscular endurance.

Basic physical abilities are a prerequisite for a successful javelin throw. To attain a high level of achievement, these skills must be developed in a systematic manner using training methods that are suitable for the age of the athletes, mainly at the secondary school level, in order to execute the throwing phases with greater coordination, smoothness and efficiency. Moreover, variety of training methods makes training enjoyable and motivates students in their training performance. Pilates training focuses on developing core muscle strength. These muscles include abdominal muscles, back muscles, and hip muscles. Further, these muscles are responsible for controlling the body. Moreover, the training improves posture, balance, and coordination. Consequently, the importance of this research is to analyze the effect of Pilates exercises on developing selected physical abilities and javelin throw performance to improve athletic performance.



1.2 Research Problem

The throwing events often make school teams perform at relatively low levels of performance. The javelin throw often performs at relatively lower levels of performance. School teams of the First Baghdad Al-Rusafa Directorate of Education are no exception. This weakness has surfaced by the researcher's encounter while teaching and coaching. In order to overcome this challenge, the researcher implemented a Pilates training programmed to develop the specific physical requirements of the event, improve performance and enhance the achievement of javelin throw among the female secondary school students.

1.3 Research Objectives

- The proposal aims to create a program of Pilates exercises for female students of the fourth grade of secondary school.
- The purpose of the study is to find out effect of Pilates exercises on the selected physical abilities (explosive strength and flexibility).
- The purpose of this study is to assess the impact of Pilates on javelin throwing performance of female students.

1.4 Research Hypotheses

Pilates exercises have a statistically significant effect on selected physical abilities of the research sample.

There is a strong relationship between Pilates exercise and javelin throw among female secondary school athletes.

The research groups' pre-test and sat post-test scores were statistically significantly different in terms of the physical ability and performance achievement.

1.5 Research Scope

The participants of the study will be the female students of fourth grade at Al-Shaab Secondary School for Girls, First Baghdad Al-Rusafa Directorate of Education.

The sports field of Al-Shaab Secondary School for Girls.

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Duration: Commencing on 15 February 2026 and ending on 22 April 2026 during 2025-2026.

1.6 Definition of Terms

The offer of Pilates Exercises entails a training system developed to strengthen the muscles of the body through a series of exercises. The main aim is to enhance and develop the core muscle strength especially the muscle of abdomen, back and hip. The muscles stabilize body, control body and provide muscular stability. And also improve posture, balance and coordination of body.(1)

Chapter Two

Research Methodology and Field Procedures

2.1 Research Method

The researcher adopted the experimental method using two groups (experimental and control) because it was considered the most appropriate design for addressing the research problem.

2.2 Research Population and Sample

The research population is female students in schools affiliated with the First Directorate General of Al-Rusafa Education. The chosen sample was deliberately drawn from the fourth graders at Al-Shaab Secondary School for Girls with seven classes. B and D were two classes that were randomly selected. Class D served as the experimental group with 20 students, while class B served as the control group with 20 students. Students that were absent, medically exempt or repeater were not part of the sample.



Table (1): Homogeneity of the Research Sample According to Height, Age, and Body Mass

Group	Variable	Unit	Mean	SD	Variance	Skewness	Kurtosis	Significance
Experimental	Height	cm	160.00	4.078	16.632	-0.708	0.388	Not Significant
	Age	years	16.869	0.517	0.268	0.192	-0.011	Not Significant
	Body Mass	kg	54.000	5.703	32.526	-1.301	0.045	Not Significant
Control	Height	cm	160.00	4.196	17.608	-1.433	0.125	Not Significant
	Age	years	17.040	0.493	0.244	0.490	0.515	Not Significant
	Body Mass	kg	55.950	5.576	31.103	-0.083	-0.409	Not Significant

Significance level: 0.05

2.3 Data Collection Methods, Instruments, and Equipment

2.3.1 Data Collection Methods

The following methods were used:

- Previous studies and research.
- Arabic and foreign references.
- Observation and experimentation.
- Opinions of experts and specialists.
- Internet resources.
- Testing and measurement.

2.3.2 Instruments and Equipment

30-meter measuring tape.

Medical weighing scale.

Javelin throwing field.

30 cm wooden box.

3 kg medicine ball.

Gym mat.

Colored marker.

Recording forms.

Three javelins.

Training poles.

Dell laptop computer.



2.4 Field Procedures

2.4.1 Physical Ability Tests Used in the Study

First Test: Seated Medicine Ball Throw Test (3 kg) for Arm Explosive Strength (3)

Purpose of the Test: (2)

To measure arm muscular strength and explosive power.

Equipment:

A 3-kg medicine ball, measuring tape, and recording form.

Performance Description:

The participant sits in a long-sitting position with a slight separation between the legs and the back firmly against the chair. Holding the medicine ball at chest level, the participant throws the ball forward with maximum possible force.

Scoring:

The distance from the point where the ball lands to the wall is measured. The measurement unit is meters/centimeters (m/cm).

Second Test: Sit-and-Reach Test (4)

Purpose of the Test: (3)

To measure the flexibility of the back and thigh muscles during forward trunk flexion from the long-sitting position.

Equipment:

A graduated cardboard box (30 cm high) with a measuring scale mounted on top so that the zero mark is level with the upper surface of the box, and an exercise mat.

Performance Description:

The participant sits in a long-sitting position with both legs fully extended and the soles of the feet touching the front of the box. The arms are extended forward with one hand placed over the other. The participant bends the trunk forward as far as possible over the measuring box without bending the knees.

Scoring:

The distance reached by the fingertips is recorded in centimeters (cm).

Third Test: Standing Javelin Throw Performance Test (Achievement)



Purpose of the Test:

To determine the participant's performance level.

Objective:

To measure the throwing distance.

Equipment:

A throwing field, three javelins, a measuring tape, and cones to mark the throwing area.

Performance Description:

The participant stands behind the designated throwing line in the final throwing position and performs the throw. Each participant is allowed three attempts, and the best throw is recorded. Crossing the throwing line is considered a foul attempt.

Scoring:

The distance is measured from the throwing line to the point where the tip of the javelin first lands. The measurement is recorded in meters and fractions of a meter..

2.5 Pilot Study

To determine the procedures for the administration of the selected tests and to find a lot of other tests, the researcher conducted a preliminary or pilot study before the main experiment. On February 15, 2016 a pilot study was conducted using four female students outside the sample of the research.

Pre-exam.

On 16 February 2026 (Monday), 10:00 a.m., the research sample was given the pre-tests. On Al-Shaab Secondary School for Girls' sports field.

2.5.1 Pilates Exercise Program

The proposed study attempts to develop the selected physical abilities by designing a Pilates exercise training programmed and improving the performance of javelin throw according to the educational level of the subjects. The program was created taking into account specialized training literature, the



opinion of experts in sports training, and the experience of the researcher in teaching and training.

The program was implemented starting on Thursday 19 February 2026. And it is concluded on Monday 13 April 2026. The training was conducted as per schedule every Monday and Thursday

The experimental group participated in 2 months of Pilates program with 2 training sessions per week for 8 weeks. This means that the experimental group was assigned 16 training units (Appendix 2). Each training session lasted for 20 to 25 minutes and exercise intensity progressed from low to moderate.

2.5.2 Post-test

The post-tests were carried out under the same conditions as the pre-tests after the Pilates training program, which took place on Thursday 16 April 2026 at the sports field of Al-Shaab Secondary School for Girls.

2.6 Statistical Analysis

The data were analyzed using the Statistical Package for the Social Sciences (SPSS). The following statistical methods were employed:

1. Arithmetic mean.
2. Standard deviation.
3. Skewness coefficient.
4. Kurtosis coefficient.
5. Shapiro–Wilk test.
6. Student's t-test.
7. Pearson correlation coefficient.
8. Percentage of improvement.

Chapter Three

Results, Analysis, and Discussion

3.1 Presentation and Analysis of Results

The arithmetic mean, the standard deviation, the variance as well as the skewness coefficient of the pre-test results for each of the research groups.

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Table 2

The means, standard deviations, variances, and skewness for the pre-test results of both study groups.

The pre-test results of the two research groups are shown in Table (2).

The mean and standard deviation score of a control group in the medicine ball throw test (upper-limb explosive strength) is 2.800 ± 0.575 .

The average score of experimental group is 2.810 with a standard deviation of 0.453 in the same test.

The control group's average score for the sit-and-reach flexibility test was 7.40 with a standard deviation of 6.870.

The mean score of the experimental group is 6.400 with a standard deviation of 5.072.

In the standing javelin throw test, the Mean of the control group was 9.575 and its Standard Deviation was 2.290.

The mean score of the experimental group was 8.722 while the standard deviation was 1.474.

Table (3)

Means, Standard Deviations, Significance Levels, and t-values for the Post-test Results of Both Research Groups

Table (3) indicates the post-test results as follows:

The control group scored an average of 3.197 with an SD of 0.493 in the medicine ball throw test. The t-value calculated was 28.905 which was more than the tabulated value (1.729) at an error of 0.002 which was sufficient evidence to prove the improvement of Cardamom Essential Oil ($p < 0.05$)

The group receiving the experimental treatment had a mean score of 4.409 with a standard deviation of 0.581. The computed t-value was 33.876 which was greater than tabulated value of 1.729 at 0.009 level of significance which is statistically significant $p < 0.05$.

The control group achieved a mean score of 10.800 with a standard deviation of 6.614 in the sit-and-reach flexibility test. The obtained t-value was 4.817, and the tabled value was 1.729 at 0.002 ($p < 0.05$).



The experimental group recorded a mean performance score of 14.100 with a standard deviation of 5.179. The t-value calculated was equal to 12.173 which was also greater than the tabulated value of 1.729 at 0.002 p 0.05.

In the standing javelin throw test, the control group exhibited a mean score of 10.986 and a standard deviation of 2.244. The t-value computed was 21.892 which was more than the tabulated value of 1.729 at 0.014 level of significance. The average score of the experimental group was 13.30 with a standard deviation of 2.112. The t-value was calculated as 28.159, with a significant value of 0.002 which shows a statistically significant improvement ($p < 0.05$).

Table (4)

Mean Differences, Absolute Improvement, and Percentage Improvement for the Experimental Group

The results indicate the following:

- Medicine ball throw test had mean difference of 1.599, absolute improvement of 0.569 and percentage improvement of 56.9%.
- In the sit-and-reach flexibility test, the mean difference was 7.7, the absolute improvement was 1.203, and the percentage improvement was 120.31%.
- In the standing javelin throw test, a mean difference of 4.578, absolute improvement of 0.524, and percent improvement of 52.4% was recorded.

Table (5)

Mean Differences, Absolute Improvement, and Percentage Improvement for the Control Group

The results indicate the following:

- In the Medicine ball throw test, mean difference was 0.397, absolute improvement was 0.141 and percentage improvement was 14.1%.
- According to the sit and reach flexibility test, the mean difference of the study was 3.4, the absolute improvement was 0.459, and the percentage improvement was 45.9%
- According to the study, in the standing javelin throw test the mean difference was 1.411, absolute improvement was 0.147 and percentage improvement was 14.7%.



3.2 Discussion of Results

From our observation of Table (3):

There was an improvement in all tests and performance variables of control and experimental groups.

The control and experimental group's post-test mean score were different because both group experienced training in a training unit, and both groups did show more improvement than before.

As illustrated in table (4), the control group and experimental group of all the tests showed difference in the mean score between the pre-test and post-test. The experimental group performed better as compared to the control group. Table 5 also indicates a marked and evident improvement in the experimental group's percentage.

According to the researcher, the experimental group's enhancement and superiority were the result of using appropriately designed Pilates exercises. The experimental group improved the explosive strength of the arms and the flexibility of the back (spinal column) and thighs thanks to the application of these exercises. As the intensity of the training appropriate to the age of the participants that results in clear improvements (achievement) of performance. The training of beginners aims to develop comprehensive and stable physical qualities and capabilities through the use of general and specific exercises and various methods. While the specialized sports training at this stage emphasizes the emergence of qualities of tasks and readiness for a particular sport or event. At this stage, physical exercises are preferably selected, which contribute to the development of the basic physical qualities and involve complex movement patterns.

This researcher opted for Pilates exercises, as they are appropriate for the target age group and serve to develop the explosive strength and flexibility of the exercise-muscle that are used. The researcher has adopted Pilates exercise because "these exercises are known for developing muscular strength and for improving body shape and posture." (6).

In a similar manner, certainly "Pilates exercises increase the mobility of the joints and stability throughout the maximum range of movement. Further,



through static muscular contractions they increase the strength of the muscles that act on the joints. For example, by raising the trunk upwards from the prone position, the back muscles contract generating force around the joint thus increasing the flexibility of this joint.” (12)

Developing flexibility contributes to achieving the range of motion through which each joint functions according to its flexibility. The range of motion depends on how strong the working muscles are, as well as how long the opposing muscles are. Flexibility is considered a fundamental component in the development of other physical qualities such as strength, speed, and agility, in addition to the acquisition of motor performance. The flexibility of the joint reflects the range of movement possible at that joint. Thus, flexibility is also considered essential for achieving a full range of motion. Therefore, the range of motion refers to the strength of the working muscles and the extensibility of the muscles that are in opposition to them. The more flexible a joint is the greater its ability to perform its movement actions efficiently.

The researcher consents with the program of Pilates exercise applied by Samer Al-Rifai study. There is an improvement in trunk flexibility who show a positive result in the sit-and-reach test. The extensibility of the tendons and ligaments, elasticity of the muscles and structure of the joint determines the flexibility of the joints. The development of other physical capacities such as strength, speed and agility depends on flexibility. Their performance requires a wide range of joint motion, thus flexibility is important. (7).

Flexibility also plays an effective role in the performance of a variety of sports movements taking into account the nature of technical performance. Different sports have different needs when it comes to range of motion. The range of motion of the body's joints is considered one of the important components of physical preparation to achieve high levels of sports performance. (9).

The javelin throw is a sport that requires specific requirements. Explosive strength is one of those specific requirements. So, what exactly is explosive strength? Furthermore, explosive strength is the combination of strength and speed simultaneously. It refers to performing physical work characterized by maximum force and maximum speed. The term speed-strength refers to "the



maximum dynamic force that a muscle or muscle group can generate in a single effort; characterized by maximal force and maximal speed in one effort it therefore expresses maximal instantaneous speed-strength." (8).

Pilates exercises are one of a number of methods of training and physical preparation that develop muscular strength, improve movement control through the muscles of the body in general and the core muscles in particular, by re-educating intermuscular coordination and developing precision between the nervous system and muscles and vice versa. Using smooth movement patterns that are continuous in nature, Pilates movements utilise maximum muscle groups. This undertaking is aimed at bringing about strength and balancing of the body's core muscles including the abdominals, back and hips. The current study was able to achieve its objectives due to betterment in physical abilities which resulted in an enhancement of performance and achievement. (1,12).

4. Conclusions and Recommendations

4.1 Conclusions

Pilates exercises effectively enhance muscular strength of the upper-limb.

The study results indicate positive effect of pilates training on javelin throw performance of female students.

A strong and significant (statistically) relationship was observed between upper-limb strength, spinal and thigh flexibility and the performance of the javelin throw by the subjects.

4.2 Recommendations

Exercises from Pilates are recommended for use in various age groups and other sports.

Training in pilates can be used by a male or female athlete.

It is suggested that similar research be conducted on other throwing activities using Pilates program.



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Appendices

Appendix (1)

List of Experts and Specialists

No.	Name and Academic Title	Specialization	Affiliation
1	Prof. Dr. Ahlam Shaghati Mohsen	Sports Training / Track and Field	University of Baghdad, College of Physical Education and Sports Sciences
2	Assoc. Prof. Dr. Saif Mohammed Ali	Measurement and Evaluation	University of Dhi Qar, College of Physical Education and Sports Sciences
3	Prof. Dr. Yusra Hassoun Mutashar	Sports Training	University of Al-Qadisiyah, College of Physical Education and Sports Sciences for Women
4	Asst. Prof. Abbas Ali Lafta	Sports Training / Track and Field	Al-Mustansiriyah University, College of Physical Education and Sports Sciences

Appendix (2)

Sample Training Units for the Javelin Throw Using Pilates Exercises (Main Part)

Week	Exercise	Training Intensity	Repetitions	Training Objective
Week 1 Training Units 1–2	Plank Bridge Roll-Up Side Leg Lift Swimming	Low– Moderate	3 × 20 s 3 × 10 s 2 × 8 reps 2 × 10 reps 2 × 15 s	Adaptation and familiarization. Learning correct exercise technique.
Week 2 Training Units 3–4	Plank Bridge with Leg Raise Roll-Up Side Leg Lift Swimming	Moderate	3 × 12 reps 3 × 10 s 3 × 10 reps 3 × 12 reps 3 × 20 s	Increase shoulder and hip flexibility. Develop core stability. Improve balance and postural control.
Week 3 Training Units 5–6	Side Plank Advanced Bridge Teaser Side Kick Fast Swimming	Moderate– High	3 × 30 s 3 × 12 reps 3 × 8 reps 3 × 12 reps 3 × 12 reps	Improve movement control during throwing. Increase muscular strength and neuromuscular control. Enhance javelin throwing technique.
Week 4 Training Units 7–8	Plank with Arm Movement Dynamic Bridge Roll-Up Side Leg Lift Swimming	Moderate	3 × 30 s 3 × 12 reps 3 × 12 reps 3 × 15 reps 3 × 30 s	Consolidate physical improvements. Further improve technical performance in the javelin throw.