

Eight Weeks of TRX Suspension Training Effects on Muscular Power and Performance Level of some Kip Skills in Gymnastics

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Abstract

This research aims to identify the effect of eight weeks of TRX suspension training on muscular power and performance level of some kip skills in gymnastics. The researcher used the experimental design for pre-post measurement of one group to suit the nature of the research. The research sample was chosen Intentionally from gymnastics players listed in the Saudi Gymnastics Federation, from different clubs, and the basic research sample included (10) players, while the exploratory study was conducted on a sample of players representing the original community, from outside the main research sample, their number was (10) players who were chosen randomly with the aim of selecting the appropriate TRX suspension exercises and codifying it's training loads. the most important results were as follows: The percentage of improvement for the physical variables ranged between (10.5%, 27.7%), and the highest percentage of improvement was for the (Abs muscular power) by (27.7%), and the lowest percentage of improvement was for (arms muscular power) by (10.5%), and the percentage of improvement of the rest elements ranged between them, while the percentage of improvement of technical variables ranged between (15.8%, 21.5%), and the highest percentage of improvement was for (kip to support) on rings apparatus by (21.5%), and the lowest percentage of improvement was for (glide kip) on parallel bars apparatus by (15.8%), The researcher recommends using TRX suspension training to develop muscular power and performance level of some kip skills in gymnastics.

Keywords: TRX Suspension Training, Muscular Power, Kip Skills, Gymnastics

Introduction and Research Problem:

Physical preparation is the cornerstone in developing the technical performance of the gymnast. Without it, it is difficult for the player to perform the skill with its required motor paths, as well as some special exercises using equipments and tools, which affect the working muscles in the technical performance and linking them to neural paths in the direction of skill, and artistic gymnastics is characterized by multiple apparatuses and the diversity of technical performance on them. some apparatuses, the skill performance comes from the position of hanging, others from the position of support, and others from the position of running.

Physical components are the basis for the player to reach the highest levels of sports, and they are necessary qualities for all group and individual sports activities, and there are close correlative relationships between the various physical components. (Abdel-Fattah, A. & Khouribet, R. 2019: 455)

Gymnastics requires a high level of muscle strength for all parts of the body in general, and in particular for the muscles working on the hip joints, the muscles of the trunk, arms and shoulders, most gymnastics skills require exerting force at high motor speeds, and the availability of a great amount of muscular power allows the gymnast to develop his technical performance in a large number of skills. (Tolan, S. & Abu Odah, M. 2016: 127)

Training with modern equipment is one of the basics of physical preparation, as it has become one of the necessary requirements in various sports activities that can be practiced for both individual and group activities, due to its close connection with the process of developing motor skills. (Koprince, S. 2009: 51)

Total body resistance exercises are symbolized by (T.R.X), It is an innovative method in the field of sports training, suitable for both beginners and seniors, and its intensity can be graded by changing body positions relative to the attachment point, it aims to develop all kinds of strength, especially muscular power, and these exercises also work to develop coordination and flexibility for the different joints of the body. (Kenney, W. L., et al., 2019: 54)

T.R.X training is considered a revolution in the world of sports training. It is an advanced form of resistance training that aims to develop muscular strength without using weights, but only uses body weight against gravity as a natural resistance, and it can be used for everyone without discrimination in age or gender, and in a variety of ways, it can also be modified according to individual differences between players. (Comfort, P. et al., 2011: 3270)

Suspension exercises are simple and not easy exercises. There is a big difference between simple and easy. This is evident in that they are simple exercises, and their intensity can be graded from low to maximum intensity. This type of training aims to improve muscular power, balance, flexibility and coordination. (Dudgeon, W. et al., 2011: 53)

T.R.X suspension training is a modern method for developing physical fitness, as well as technical performance and gaining a competitive advantage, and it is a multi-purpose and multifunctional training tool that focuses on using the total body weight against gravity, instead of using the devices that are found in fitness halls, which made it possible to train on them outside the gyms, It is based on three basic principles: the principle of sagittal movement, which is indicated by the angle with the ground, the principle of balance, which is indicated by the nervous muscular system, and the principle of reversibility as a result of the starting position and the fulcrum point. (Dulceata, V., 2013: 141)

TRX exercises depends on the muscles of the abs, back, hips and chest. It can also increase the heart rate and burn more calories than standing and sitting during traditional exercises, thus increasing the strength of the heart muscle and increasing muscular endurance. (Koprince, S., 2009: 22)

TRX exercises are divided into 4 main groups (balance exercises - squats - push-ups - back exercises), and this tool has been very carefully designed to suit all goals. (Fong, S., et al., 2015: 2)

TRX training are characterized by the use of two straps suspended from the suspension point, in a way that allows the length of each strap to be adjusted to suit the implementation of various exercises. It is important for the suspension point to support body weight according to the requirements of the different exercises, as the use of foot cradles or hand handles at the end of each strap according to the nature of training, during all exercises, body must be work as a unified system during the dynamic movements of the exercises, and neuromuscular coordination is a main aspect of TRX training. (Gaedtke, A., & Morat, T., 2015: 252)

From the above, the researcher believes that it is possible to train all body muscles using the TRX tool, as it is a form of training that depends mainly on the resistance of body weight, it works to strengthen the basic muscles by focusing on physical effort without weights, and the development of physical components using the method of muscular work is similar to technical performance. TRX suspension training is one of the best training methods for developing gymnast physically and technically.

Through the researcher's work as an assistant professor in the Department of Physical Education and Movement Sciences - Qassim University, KSA, and head coach for the men's artistic gymnastics teams at gymnastics hall - halls complex at the same university, the researcher noticed a deficiency in the level of technical performance of some kip skills understudy, where the performance of kip skills depends mainly on the two movements of flexion and then sudden extension of the hip joint, and to accomplish kip skills, the gymnast must have a sufficient muscular power in both the abdominal and legs muscles. He must have a streamline swing and flexibility to keep the insteps close to the bar. In addition, the player needs the strength of shoulder muscles and the triceps muscle. From this it becomes clear that kip skills

require more tools to accomplish, and in order to perform kip skill of with a correct technical performance, the player first swings forward in a bent position, then raises his insteps to the bar at the most advanced point in his front swing, and with his insteps completely under the bar, the player's body begins to swing back, and then the player pulls the bar down, keeping his legs close from the bar, and when his body rises to the top, he ends up placing to support on the bar, where the player's body initially needs movement energy as a result of swing legs, and this energy is transmitted to the trunk and when it stops, it turns into position energy to reach the support position, so that the body can rise to a higher position on the apparatus.

The main objective of kip skills is to rise the body from a low level to a high level, by flexing and extending the body from the hip joint. and works on the implementation of kip skills two main groups of muscles, the first group, is abs and legs muscles, which is the motor strength for kip skills, which requires the player to exploit the movement energy resulting from the body swing during flexion and sudden extension of the hip joint, and the second group which is the muscles of the arms and shoulder and its responsibility pulling the bar down to raise the body up, and then implementing kip skills understudy in a correct technical way,

from here the research problem appeared, where the researcher noticed a varying defect in the players' ability to perform some kip skills understudy, which negatively affects the player's total score. Where the rebates for the formal defects of performance range among (0.1 - 0.3 - 0.5) of the degree according to the type of defect, and the rebate may reach (1 full degree) in case of the player lose his balance and falls during the performance of the basic technical stage of the skill and thus his inability to compete for a medal, the researcher noticed the repetition the same technical defects of the players when implementing some of kip skills understudy, and this was clear through the competitive and evaluation situations.

The researcher assumes that this problem is due to the players' lack of sufficient muscular power, due to its importance in carrying out the motor duty in the required technical form, which affects the player's degree.

Through the researcher's follow-up to the tremendous development in modern training methods using tools, to improve special physical abilities as one of the basic requirements on which technical performance is based, so the researcher sees the need to use T.R.X suspension training because it is one of the best modernized exercises that can move in more than one angle in order to develop special physical abilities and at the same time developing the technical performance of the kip skills understudy, because the performance of these exercises is in the same direction as the muscular work of the skill, especially the presence of a compatibility between the T.R.X exercises and the technical performance of the kip skills understudy in the path of movement, working muscles and the intensity of the training load.

The researcher believes that raising the technical level of the players should be through codified training programs, and the use of the best exercises and modern tools, such as the TRX exercises that contribute to the development of the players' performance. which works in the same direction of the technical performance of kip skills, as the success of the technical performance requires the development of special physical abilities. This prompted the researcher to conduct a study targeting the effect of TRX suspension training effects on muscular power and performance level of some kip skills in gymnastics.

By reviewing the previous and related studies, the researcher noticed a scarcity of training programs using TRX exercises in gymnastics, especially on the kip skills understudy, which requires conducting an experimental study as an attempt to develop the level of technical performance of the players' understudy. Therefore, the researcher resorted to designing and

codifying a training program using the TRX tool, to identify its effect on muscular power and performance level of some kip skills in gymnastics.



Figure (1)
TRX suspension training tool

Research Aims:

The research aims are to identify the effect of eight weeks of TRX suspension training on muscular power and performance level of some kip skills in gymnastics, through research goals:

- Developing the level of muscular power for the sample members understudy.
- Developing the level of technical performance of some kip skills understudy.

Research Hypothesis:

- There are statistic significant differences between pre & post measurements of the sample members understudy in the level of muscular power understudy in favor of the post measurement.
- There are statistic significant differences between pre & post measurements of the sample members understudy in the performance level of some kip skills understudy in favor of the post measurement.

Research Terms:

- **TRX suspension training**

Total body resistance exercises are symbolized by (T.R.X), It is an innovative method in the field of sports training, suitable for both beginners and seniors, and its intensity can be graded by changing body positions relative to the attachment point, it aims to develop all kinds of strength, especially muscular power, and these exercises also work to develop coordination and flexibility for the different joints of the body. (Kenney, W. L., et al., 2019: 54).

- **Kip Skills**

It is a set of skills that are performed on more than one apparatus (parallel bars, horizontal bar, Rings), where the implementation of kip skills depends mainly on the two movements of flexion and then the sudden extension of the hip joint, with the aim of raising the center of gravity of the body from a low level to a higher level. (Procedural definition)

Research Procedures:

- **Research Methodology:**

The researcher used the experimental method using the experimental design of one group and by making the two measurements (pre-post).

- **Spatial Domain:** gymnastics hall - halls complex at Qassim University - Buraidah City - Kingdom of Saudi Arabia. This hall is not only for physical education students, but also for

serving the external community, so most of the players in the surrounding clubs are interested in training in this hall, because of its standard apparatuses and tools, and specialized technical staff. It includes teams of various stages of age.

- **Time Domain:** The exploratory study was conducted in the time period from Saturday 21/5/2022 to Saturday 28/5/2022, and the pre-measurement was conducted on Wednesday, 1/6/2022. The basic study was carried out during the period from Saturday 4/6/2022, until Friday 29/7/2022, and the post-measurement was conducted on Sunday 31/7/2022.

- **Research Sample:**

The sample of the basic study was chosen intentionally from gymnastics players listed in the Saudi Gymnastics Federation, from different clubs, the sample included (10) players, while the exploratory study was conducted on a sample of players representing the original community and from outside the basic research sample, and their number reached (10) players who were chosen randomly with the aim of selecting suitable TRX suspension exercises related to the technical performance of kip skills understudy, and codify the training load of these exercises.

Statistical description of sample

Table (1)
Statistical description of growth rates variables
(Height - Weight - Age - Training Age)

(n=10)

	Statistical data Variables	Measuring unit	Mean	Standard deviation	Median	Coefficient of torsion
Growth rates	1 Tall	cm	168.1	2.469	168.5	- 0.485
	2 Weight	Kg	65.78	1.346	65.95	- 0.379
	3 Age	Year	17.6	0.646	17.7	- 0.464
	4 Training age	Year	12.82	0.705	12.8	0.085

From Table (1) it is clear that the values of the torsion coefficient for each of the growth rates variables understudy ranged between (-0.485, 0.085) and these values were limited between (± 3) which indicates the moderation of the values of the growth rates of the individuals in the sample understudy before experimenting.

Table (2)
Statistical description of physical variables

(n = 10)

Variables	Test	Measuring unit	Mean	Standard deviation	Median	Coefficient of torsion
Muscular power	3kg medicine ball push	m	4.31	0.453	4.35	- 0.264
	4m climbing rope	s	4.85	0.506	4.9	- 0.296
	45s Sit ups	n	33.2	1.751	33.5	- 0.514

From Table (2) it is clear that the values of the coefficient of torsion for each of the physical variables understudy ranged between (- 0.514, - 0.264) and these values were limited between (± 3) which indicates the moderation of the values for the physical variables of the sample individuals understudy before experimenting.

Table (3)
Statistical description of technical variables

Technical variables		Measuring unit	Mean	Standard deviation	Median	Coefficient of torsion
1st skill	Glide Kip Parallel Bars	degree	7.72	0.405	7.7	0.148
2nd skill	Kip to hdst Horizontal Bar	degree	7.09	1.039	6.95	0.404
3rd skill	Kip to Support Rings	degree	6.42	1.329	5.9	1.173

(n = 10)

From Table (3) it is clear that the values of coefficient of torsion for each of the physiological & technical variables understudy ranged between (0.148, 1.173) and these values were limited between (± 3) which indicates the moderation of the values for technical variables of the sample individuals understudy before experimenting.

Means of data collection:

The researcher used the following methods to collect data:

- Means of collecting data related to anthropometric measurements.
- Means of collecting data related to physical variables.
- Means of collecting data related to technical variable.

Means of collecting data related to anthropometric measurements:

The means and tools for data collection that are appropriate to the nature of the study were identified by looking at the scientific references, research and previous studies in the field of gymnastics training and some other sports. The researcher has used the following tests, measures and devices:

- A rest-meter device for measuring the total length of the body up to the nearest 1 cm.
- The medical scale device to measure the player's weight up to the nearest 1 kg.

Means of collecting data related to physical variables understudy:

Physical Variables Tests understudy attachment (6)

- 3kg medicine ball push test (to measure muscular power of the arms muscles)
- 4m climbing rope test (to measure muscular power of the arms muscles)
- 45s Sit ups test (to measure muscular power of the Abs muscles)

(Allawi, M. & Radwan, M. 2017: 214); (Hassanein, M. 2015: 133)

Means of collecting data related to technical variables.

The technical skills understudy was filmed using the "video camera" and the videos were shown to four arbitrators accredited by the Egyptian Gymnastics Federation to evaluate the technical performance of the skills understudy, each arbitrator puts a score of ten degrees for each technical skill understudy, the highest and lowest score has been deleted so that the player's score is the average of the two middle scores.

Subjective Evaluation is the type of evaluation that does not depend on the standards, levels, and criteria, but depends on the experiences of the measurers (arbitrators), subjective evaluation is used in many of sports activities, especially gymnastics, diving, rhythmic gymnastics and water ballet, where unified international legal conditions are set, agreed upon in advance between the arbitrators, in order to reach the greatest degree of objectivity in evaluating the degree. (Khalil, M. 2020: 9); (Hassanein, M. 2015: 42)

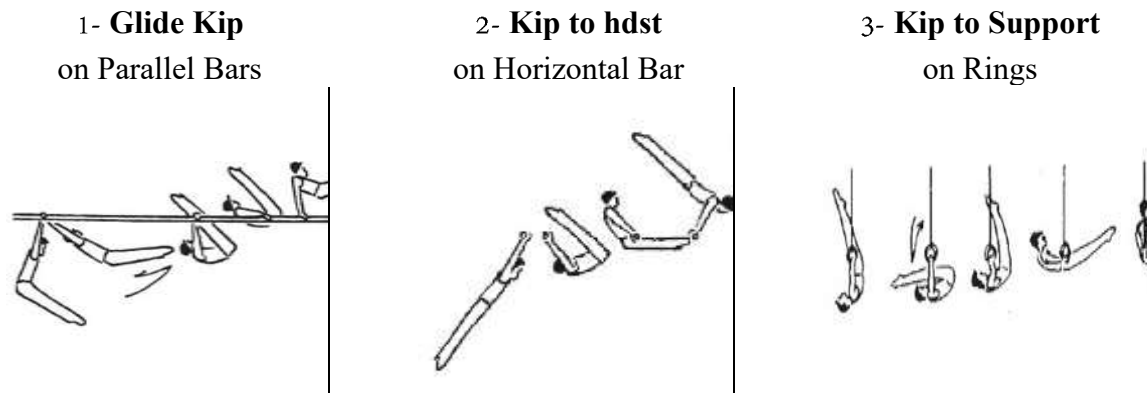


Figure (2)
Kip Skills understudy

(G.I.F. 2020: 133)

Selecting the assistants:

A number of (2) assistants from the department of Physical Education & Movement Sciences, were chosen to assist the researcher in applying the study procedures.

The Exploratory Study:

The researcher conducted the exploratory study in the time period from Saturday 21/5/2022, to Saturday 28/5/2022, on a sample of players representing the original community and from outside the main research sample, and their number reached (10) players who were chosen randomly. Pre-measurement was carried out on Wednesday, 1/6/2022.

This study has targeted:

- Ensure the safety of the devices and tools used
- Training assistants to take measurements and ensure that the tests are applied according to the specified conditions
- Selection and experimenting TRX exercises and their compatibility with the technical performance of the kip skills understudy.
- Rationing of training load variables for the TRX exercises understudy.
- Conducting scientific transactions for the tests used (validity and reliability) and ensuring their suitability to the research sample.
- Setting the best camera angle to facilitate the process of evaluating the technical performance of the skills understudy.

The Exploratory Study resulted in:

Ensure that all of its objectives are achieved, and that the suggested TRX suspension training understudy is appropriate for the nature of the sample age, as the members of the exploratory sample performed the suggested TRX exercises without any difficulties, which made the researcher the possibility of applying these exercises to the individuals of the basic research sample.

• Scientific Transactions:

- Validity coefficient

The researcher calculated the validity coefficient using the method (validity of differentiation), between two groups, one distinguished and numbered (5) players, and the other less -distinguished numbered (5) players, from the same research community and from outside the basic research sample, in order to calculate the validity coefficient of the physical and technical tests understudy, as shown in Table No. (4)

Table (4)
Differentiation validity of physical and technical tests understudy

n1=n2=5

Variables	Test	Measure unit	distinguished group		less distinguished group		Subtract averages	T test
			Mean	St.D.	Mean	St.D.		
Muscular power	1 3kg medicine ball push	m	4.660	0.288	3.960	0.270	0.700	3.963*
	2 4m climbing rope	s	5.260	0.230	4.440	0.320	0.820	4.642*
	3 45s Sit ups	n	34.40	0.547	32.00	1.732	2.40	2.954*
1st skill	4 Glide kip Parallel bars	degree	8.06	0.207	7.380	0.192	0.680	5.376*
2nd skill	5 Kip to hdst Horizontal bar	degree	7.90	0.651	6.280	0.605	1.620	4.070*
3rd skill	6 Kip to support Rings	degree	7.420	1.132	5.420	0.443	2.00	3.677*

Tabular T value at a significant level of 0.05 = 1.860 on one side * = significant

It is clear from Table No. (4) and by applying the “T” test to calculate the significance of the differences between two independent groups, one distinguished and the other less - distinguished, that the calculated “T” value, which was ranged between (2.954, 5.376), is greater than the tabular “T” value at a significant level. (0.05), which amounted to (1.860), which indicates that there are statistically significant differences between the two groups in favor of the distinguished group, which confirms the validity of the tests understudy in what they were designed to measure, and that they can differentiate between the distinguished and less - distinguished players of the same age group.

- Reliability Coefficient

The reliability coefficient was calculated using the method of applying and reapplying the test (Test - Retest), for the physical and technical tests understudy, the first application of the tests was conducted on 21/5/2022 on a sample of (10) players. While the second application took place on 28/5/2022, with an interval of 6 days. And calculate the correlation coefficient between them, as shown in Table (5).

Table (5)
Reliability coefficient of physical and technical tests understudy

n=10

Variables	Test	Measure unit	TEST		RE-TEST		Correlation Coefficient
			Mean	St.D.	Mean	St.D.	
Muscular power	1 3kg medicine ball push	m	4.310	0.453	4.415	0.437	0.991*
	2 4m climbing rope	s	4.850	0.506	4.940	0.470	0.985*
	3 45s Sit ups	n	33.20	1.751	34.10	2.131	0.873*
1st skill	4 Glide kip Parallel bars	degree	7.720	0.404	7.800	0.385	1.000*
2nd skill	5 Kip to hdst Horizontal bar	degree	7.090	1.039	7.155	1.050	1.000*
3rd skill	6 Kip to support Rings	degree	6.420	1.329	6.515	1.328	0.997*

Tabular value "r" at the level of significance 0.05 = 0.564 on one side * = significant

It is clear from Table (5) that the values of “r” of physical and technical tests understudy ranged between (0.873, 1.000), which is greater than the tabular value of “r” at the level of significance (0.05), which amounted to (0.564), which indicates the existence of a relationship a statistically significant correlation between the Test & Re-test, which confirms the reliability of the tests understudy.

- **Basics of design the program**
- **Determining the stages of performance and working muscles of the kip skills understudy:**

Table (6)
Phases of performance and working muscles of kip skills

Phases of performance			
Glide Phase (Downswing)	Glide Phase (Sweep)	Pike Phase	Kip Phase
working muscles			
1- Hip flexor muscles: Abdominal muscles and quadriceps 2- Hip extensor muscles: Back muscles and posterior thigh muscles		3-The muscle which pulling the bar down: deltoid & triceps 4-Muscles responsible for stabilizing movement: gluteus maximus	

(Heinen, T., et al., 2013: 84)

- **Suggested TRX Suspension Training:**

The researcher applied a group of TRX Suspension Training exercises attachment (6) that correspond to the motor paths of the technical skills understudy. Exercises are divided into:

- 1- TRX suspension training exercises for the trunk.
- 2- TRX suspension training exercises for arms muscles.
- 3- TRX suspension training exercises for legs muscles.

The researcher also took into account when designing these exercises, the following:

- It should contain the basic stages of kip skills understudy or some of its phases.
- Simulating the actual performance of kip skills in terms of strength, speed, direction of movement, and accuracy of performance.
- Codify TRX suspension training exercises to determine to determine the training load variables for each exercise.
- Gradual exercises from easy to difficult and from simple to complex with its diversity.

- **Training load variables for the proposed TRX suspension training exercises:**

The researcher has codified the training load variables for the proposed TRX suspension training exercises by reviewing previous and related studies, specialized references, sports training science references and the international information network. attachment (7)

1- **Intensity:** The researcher relied on calculating pulse rates to determine the intensity of the training load Using the Carvonein equation to calculate the Target Pulse Rate (TPR)

$$TPR = \text{resting pulse rate} + \text{target load intensity} \times (\text{heart rate reserve})$$

Table (7)

Intensity Percentage		
load degrees	Percentage	Pulse Rate
Medium	50 : 74%	130 : 150 p/m
high	75 : 84%	150 : 170 p/m
Maximum	85 : 100 %	170: 200 p/m

The researcher took into account the gradual increase in the intensity through the gradual control of its variables, and the times of the training loads were organized and distributed over the training weeks and the appropriate degrees of load during the period of training application.

2- **Volume, (Repetitions – Sets):**

TRX suspension training exercises were applied in the main part of the training unit, and the exercise performance time was for (20-30) seconds with high intensity, followed by (10-15) seconds of positive rest, and the exercise was repeated (8) sets, the time for performing 8 sets of each exercise reached (4) minutes, rest after each exercise, (1) minute in a session extending to (20-40) minutes.

3- **Rest Periods:** Determining the appropriate intermittent rest time after performance based on TRX suspension training, the exercise performance time was for (20-30) seconds with high intensity, followed by (10-15) seconds of positive rest.

• **Program Duration:**

- The duration of TRX suspension training program was (8 weeks), with 4 training units per week.
- The researcher determined the time of the training unit in the week with an average load between (90 - 120 min), taking into account the wavy load between the training units.
- The time of The duration of TRX suspension training exercises within the training unit was on average (20-40) minutes. The load intensity used (high intensity).

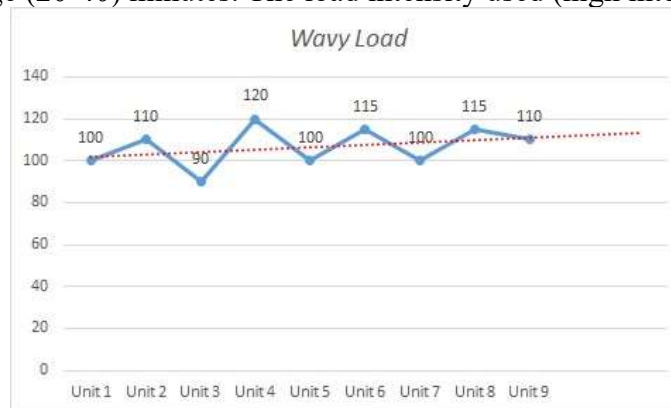


Figure (3)

Wavy Load of training units

The distribution of training load degrees over the training weeks during the stages of the training program to the degree of the average load between (50 -74%), the high load between (75 - 84%) and the maximum load between (85 - 100%).

- The stages of applying the suggested TRX suspension training program:

Table (8)

Stages of applying TRX suspension training program				
Stages	Weeks	Units/ week	unit time	Load Cycle
First stage	2			
Second stage	2	4	90 - 120 minutes	1 : 2
Third stage	4			

Training methods: The researcher used: Interval training (high and low intensity)

Training Load Cycle: Formation the training load cycle on units was chosen using the way of training load (1: 2), which means a medium load for one unit, followed by a high load in the following two units.

Basic study: The basic study was carried out during the period from Saturday, 4/6/2022, until Friday, 29/7/2022, and the post-measurement was conducted on Sunday, 31/7/2022, and the pre & post technical performance was filmed at the gymnastics hall in Sports halls complex. on the campus of Qassim University. As shown in the time distribution table of research application, attachment (10).

TRX suspension training program exercises were applied to the basic research sample in the physical preparation part of the training program, where the time of performing these exercises per week ranged between (80 - 160) minutes, for a period of 8 weeks, with 4 training units per week.

Table (9)

Axes of the training program

	Axes	Content
1	program duration	8 weeks
2	Number of training units in the program	32 training units
3	Number of training units per week	4 training units
4	training unit time	(90 - 120) minutes average 105 minutes
5	TRX training time in the training unit	(20-40) minutes average 30 minutes
6	Total program time	3360 minutes 100%
7	General physical preparation time	1612 minutes 48% of the total time
8	Private physical preparation time	1031 minutes 64% of physical preparation
9	TRX training time in the program	484.5 minutes 47% of private preparation
10	Technical preparation time in the program	1748 minutes 52% of the total time
11	Training load degrees used	Medium - High - Max
12	Training load weekly cycle	(1 : 2)

Statistical Treatments: The researcher used the program (Statistical Package for Social Sciences) (SPSS v25) Using the following statistical parameters:

Mean - Standard Deviation – Median - Torsional coefficient – Wilcoxon test - Percentage of improvement.

Presentation and discussion of the results:

Present the results:

Presenting the results of the first hypothesis:

Table (10)
Significance of differences between pre & post measurements for the experimental group in physical variables understudy

n = 10

Physical Variables	Test	Pre mean	Post mean	Positive ranks		Negative ranks		(Z) Value
				Mean rank	Sum of ranks	Mean rank	Sum of ranks	
Muscular power	1 3kg medicine ball push	4.310	5.490	5.5	55	0.00	0.00	-2.911*
	2 4m climbing rope	4.850	4.340	0.00	0.00	5.5	55	-2.213*
	3 45s Sit ups	32.20	42.40	5.5	55	0.00	0.00	-2.972*

* Tabular value (Z) at the level of 0.05 = ± 1.96

From Table (10) it is clear that the calculated value of (Z) for each of the physical variables understudy has ranged between (-2.972, -2.213) and these values are not limited to (± 1.96) which indicates the presence of statistically significant differences. between the mean of the pre-post measurements of the experimental group in favor of the post measurement at the level of significance (0.05) in the physical variables understudy.

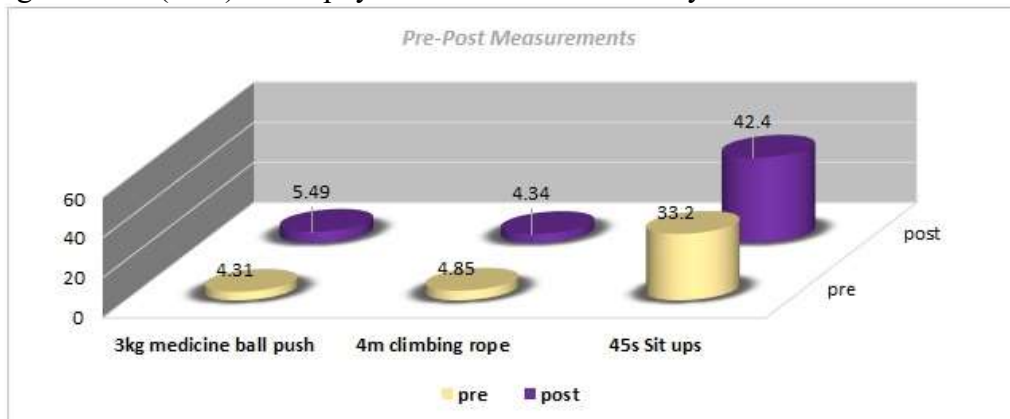


Figure (4)

Significance of differences between pre & post measurements for the experimental group in physical variables understudy
Table (11):

Percentage improvement of the experimental group in physical variables understudy

Physical Variables	Test	Pre mean	Post mean	Means Difference	Percentage of improvement
Muscular power	1 3kg medicine ball push	4.310	5.490	1.180	27.4%
	2 4m climbing rope	4.850	4.340	0.510	10.5%
	3 45s Sit ups	32.20	42.40	9.20	27.7%

From Table (11) it is clear that the percentage of improvement of the experimental group in the physical variables understudy ranged between (10.5%, 27.7%) and the highest percentage

of improvement was for the variable of abs muscular power by (27.7%), and the lowest percentage of improvement was for the variable of arms muscular power by (10.5%), and the percentage of improvement of the rest variables ranged between them.

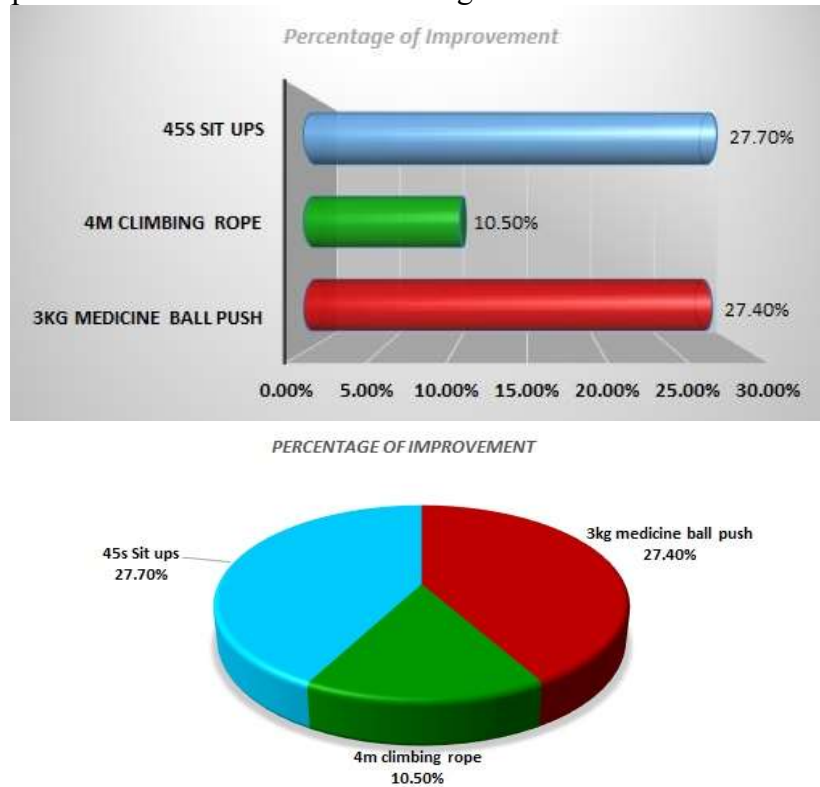


Figure (5)
The percentage improvement in the physical variables understudy

Presenting the results of the second hypothesis:

Table (12)

Significance differences between pre & post measurements for the experimental group in technical variables understudy

n = 10

Technical Variables	Pre mean	Post mean	Positive ranks		Negative ranks		(Z) Value
			mean rank	Sum of ranks	mean rank	Sum of ranks	
1st skill 1 Glide kip Parallel bars	7.720	8.94	5.5	55	0.00	0.00	-2.714*
2nd skill 2 Kip to hdst Horizontal bar	7.090	8.380	5.5	55	0.00	0.00	-2.199*
3rd skill 3 Kip to support Rings	6.420	8.940	5.5	55	0.00	0.00	-2.701*

* Tabular value (Z) at the level of 0.05 = ± 1.96

From Table (12) it is clear that the calculated value of (Z) for technical variables understudy has ranged between (-2.199, -2.714) and these values are not limited to (± 1.96) which indicates the presence of statistically significant differences. between the mean of the pre-

post measurements of the experimental group in favor of the post measurement at the level of significance (0.05) in technical variables understudy.

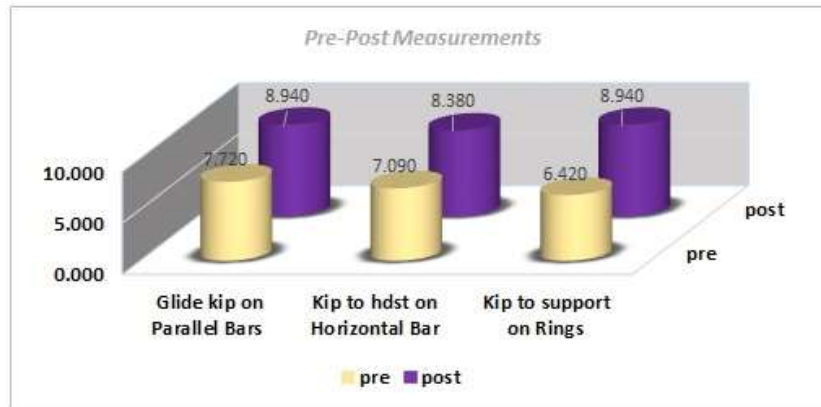


Figure (6)
Significance differences between pre & post measurements for the experimental group in technical variables understudy
Table (13)

Percentage improvement of the experimental group in physiological & technical variables understudy

Technical Variables			Pre mean	Post mean	Means Difference	Percentage of improvement
1st skill	1	Glide kip Parallel bars	7.720	8.94	1.220	15.8%
2nd skill	2	Kip to hdst Horizontal bar	7.090	8.380	1.290	18.2%
3rd skill	3	Kip to support Rings	6.420	8.940	1.380	21.5%

From Table (13) it is clear that the percentage of improvement of the experimental group in technical variables understudy ranged between (15.8%, 21.5%) and the highest percentage of improvement was for kip to support on rings by (21.5%), and the lowest percentage of improvement was for glide kip on parallel bars by (15.8%), and the percentage of improvement of kip to hdst on horizontal bar ranged between them by (18.2%).

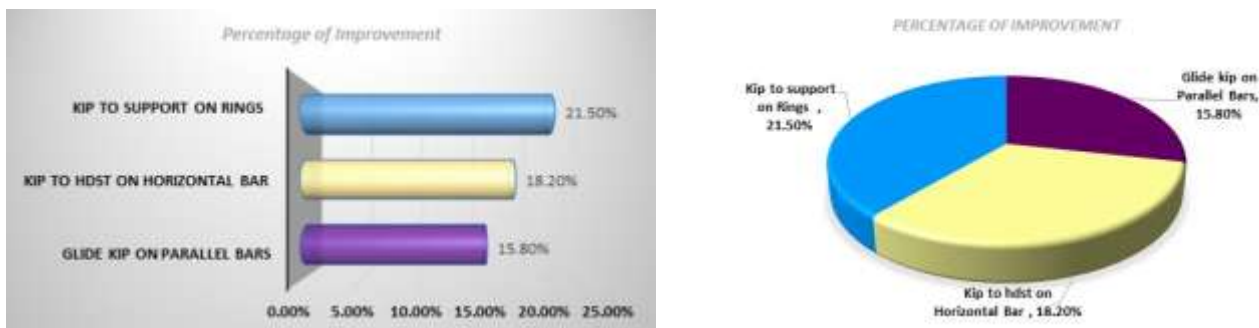


Figure (7)
Percentage improvement of the experimental group in technical variables understudy

Discuss the results:

Discussing the results of the first hypothesis:

Which states, "There are statistically significant differences between the pre and post measurements of the experimental group in the physical variables understudy in favor of the post measurement."

It is clear from Table No. (10) and Figure No. (4) that there are statistically significant differences at the level (0.05) between the pre and post measurements of the experimental group in favor of the post measurement in the physical variables understudy, where the tabular (Z) value was at the level of $0.05 = (\pm 1.96)$, while the calculated (Z) values for the physical variables understudy ranged between $(-2.213, -2.972)$ and that all of these values are less than (-1.96) , meaning that they are not limited between (± 1.96) , which indicates the existence of statistically significant differences between the means of pre & post measurements of the experimental group in favor of the post-measurement at the level of significance (0.05) in physical variables understudy. The researcher attributes these results to the effect of the TRX exercises used, and the regularity of training weekly for a period of (8) weeks, at a rate of (4) training units per week.

It is also evident from Table No. (11) and Figure No. (5) that there are statistically significant differences between the pre and post measurements of the experimental group in favor of the post-measurement in the physical variables understudy, with percentage of improvement that ranged between (10.5%, 27.7%) and the highest percentage of improvement was for the variable of abs muscular power by (27.7%), and the lowest percentage of improvement was for the variable of arms muscular power by (10.5%), and the percentage of improvement of the rest variables ranged between them.

In light of the previous improvement rates, it was found that the proposed TRX suspension exercises had positive effect on physical variables understudy for the players, as TRX suspension exercises were characterized by specific goals and diverse and interesting methods that motivate the players, the researcher took into account the codifying the training loads according to the players' capabilities, taking into account individual differences and gradation when implementing, adjusting rest periods to give the body's systems an opportunity to adapt, and applying the principle of privacy in training that takes into account the specificity of muscular work, the form and path of motor performance, and the prevailing energy system. The researcher took into account the training of motor muscles as well as the supporting muscles, for balanced muscle development, without defect the technical performance and to avoid injuries.

The researcher attributes the positive effect on the physical variables understudy (muscular power) to the TRX suspension exercises used, where the researcher took into account, during the design of the exercises, the diversity of muscular work directions, and the using of physical variables in the motor paths of the technical skills understudy, which contributed to the development of muscular power of the research sample members.

Total body resistance training TRX works to improve muscle strength, muscular power, balance, flexibility, neuromuscular coordination, as well as developing muscle work in the direction of motor performance similar to sports skill in addition to strengthening and flexibility of body joints. (Janot, J., & Welles, C. 2013: 24); (Carbonnier, A., & Martinsson, N. 2012: 12)

TRX suspension tool is designed to use body weight as a rated resistance and use it as a training aid to develop muscular power, balance and general flexibility, as it has a different design than ordinary ropes, and can be used alone or combined with another training method to develop physical components or skill performance. (Dulceata, V. 2013: 140)

Gymnastics is depending on long-term planning to prepare the gymnast in a comprehensive and balanced manner, especially physical abilities, to help the gymnast to meet the new skill requirements on different apparatuses. (Al-Hadi, A. 2017: 291)

Total body resistance training TRX has led to the development of fitness components, especially the muscular power. (Demirarar, O., et al., 2021: 77); (Tinto, A., et al., 2016: 745)

The highest percentage of improvement for (abdominal muscular power) was (27.7%), and the researcher attributed this to the direction of muscular work of the TRX exercises understudy, which were carefully designed to conform to the nature of the technical performance of kip skills, through flexion and sudden extension of the hip joints.

In this regard, performance requirements on gymnastics apparatuses are considered the most important components of building training programs, as well as continuous interest in developing methods of physical preparation, and muscular power is extremely important in gymnastics as a basic physical requirement. (Abdel-Baseer, A. 2019: 18)

The researcher also attributes these statistically significant differences between the averages of the pre and post measurements and the percentages of improvement in the physical variables understudy (muscular power) to the positive effect of the various TRX exercises.

In this regard, regular training causes several physiological changes to the muscle, represented by an increase in the size of the muscle fibers, and thus increasing the ability of the nervous system to produce the contraction of the fibers, which leads to an increase muscular power. (Shehata, M. 2019: 56)

Total body resistance training TRX had a positive effect on improving the specific physical characteristics (muscular power, dynamic balance, flexibility), and recommended conducting more scientific studies related to TRX training to know its effectiveness in various sports activities. (Elarby, A. 2022: 7); (Afifi, M. 2021: 413); (Shebl, A. 2021: 253); (Gaedtke, A., & Morat, T. 2015: 224)

Based on the foregoing results, the first hypothesis has been achieved, which states: "There are statistically significant differences between pre & post measurements of the experimental group in the physical variables understudy in favor of the post-measurement".

Discussing the results of the second hypothesis:

Which states, "There are statistically significant differences between pre & post measurements of the experimental group in the level of technical performance of some kip skills understudy in favor of the post measurement."

It is clear from Table No. (12) and Figure No. (6) that there are statistically significant differences at the level (0.05) between pre and post measurements of the experimental group in favor of the post-measurement in technical variables understudy, where the tabular (Z) value was at the significance level of $0.05 = (\pm 1.96)$, while the calculated (Z) values of the technical variables understudy ranged between (-2.199, -2.714), and that these values are all less than (-1.96), meaning that it is not limited between (± 1.96) , which It indicates that there are statistically significant differences between the means of the pre and post measurements of the experimental group at the level of significance (0.05) in technical variables understudy in favor of the post-measurement.

As it is clear from Table No. (13) and Figure No. (6) that there are statistically significant differences between the pre and post measurements of the experimental group in favor of the post-measurement in technical variables understudy, with percentage of improvement that ranged between (15.8%, 21.5%), As the average skill of the Glide kip on the

parallel bars apparatus in the pre-measurement reached (7,720) degrees, and the development in the post-measurement reached (8.94) degrees, with percentage of improvement of (15.8%), and the average skill of the Kip to hdst on horizontal bar apparatus In pre-measurement reached (7,090) degrees, and the development in post-measurement reached (8,380) degrees, with percentage of improvement of (18.2%), while the average degree of the skill of Kip to support on rings apparatus in pre-measurement reached (6,420) degrees and the development in the post-measurement reached (8,940) degrees, with percentage of improvement of (21.5%).

The researcher attributes these statistically significant differences between the means pre & post measurements and the percentage of improvement in technical variables understudy to the implementation of TRX exercises used in the main part of the training unit, as shown in attachment (6), where the researcher took into account during the design of the exercises the diversity of muscular work direction, and the employment of physical variables In the motor paths of the technical skills understudy, The time to perform each exercise for (20-30 seconds) with high intensity, followed by positive rest for (10-15 seconds), and the exercise was repeated (8) sets, time for performing groups of each exercise reached (4) minutes, Rest after each exercise (1) minute in a session of (20-40) minutes. The duration of the training program was (8 weeks), with 4 training units per week.

TRX suspension exercises develop technical performance as well as developing special physical abilities through the mechanism of these exercises as a result of different position of support, and they need harmony of muscular work, between working and opposite muscles as a result of diversity between stability and motor exercises, which helps the body to work as one unit to maintain balance, TRX tool improve muscle tone. (Kosmata, A., 2009: 49)

The researcher also attributes the improvement in the level of technical performance to the application of full-body resistance training T.R.X. It is a form of training that depends primarily on the resistance of body weight. It works to strengthen the core muscles by focusing on physical effort without weights. The development of physical abilities using the muscular work method similar to technical performance is one of the best training methods for developing techniques.

Total body resistance training using the TRX suspension tool had a positive impact on the development of the technical performance level of kip skills understudy, due to the development of the physical requirements for the implementation of kip skills through TRX exercises, especially the muscular power requirement, in addition to the similarity of the performance of these exercises with the technical performance of kip skills. And recommended conducting more scientific studies related to TRX exercises to know its effectiveness on different gymnastics equipment. (Jihad, W. 2022: 197); (Reda, N. et al., 2022: 66); (Okasha, M. 2021: 501); (Heinen, T. et al., 2013: 83)

Based on the foregoing results, it is clear that the proposed TRX exercises have a positive effect on the level of technical performance of kip skills understudy, through the development of special physical requirements and their employment in the same motor path of skill performance.

Thus, the second hypothesis has been achieved, which states, " There are statistically significant differences between pre & post measurements of the experimental group in the level of technical performance of some kip skills understudy in favor of the post measurement."

Conclusions and Recommendations:

- **Conclusions:**

Based on what the research results showed, and in light of the research goal and hypotheses, the researcher reached the following conclusions:

• **The suggested TRX exercises are effective on muscular power understudy, through:**

- The percentage of improvement in the physical variables understudy ranged between (10.5% and 27.7%).
- The average degrees of arms muscular power in test of pushing a medical ball 3kg in the pre-measurement reached (4.410 m) and an improvement in the dimensional measurement reached (5.490 m), with an improvement rate of (27.4%).
- The average degrees of arms muscular power in test of (climbing rope 4-meters) in the pre-measurement reached (4.850 s) and improve in the post-measurement reached (4.340 s) with an improvement rate of (10.5%).
- The average scores of abdominal muscular power in the test of (Sit ups 45 seconds) in the pre-measurement reached (33.20 repetitions) and improve in the post-measurement reached (42.40 repetitions), with an improvement rate of (27.7%).

• **The suggested TRX exercises are effective on kip skills understudy, through:**

- The percentage of improvement in technical variables understudy ranged between (15.8%, 21.5%).
- The average scores of skill of the Glide Kip on parallel bars apparatus in the pre-measurement reached (7.720) degrees, and develop in post-measurement reached (8.94) degrees, with an improvement rate of (15.8%).
- The average scores of skill of Kip to hdst on horizontal bar apparatus in pre-measurement reached (7.090) degrees, and develop in post-measurement reached (8.380) degrees, with an improvement rate of (18.2%).
- The average scores of skill of Kip to support on rings apparatus in pre-measurement reached (6.420) degrees and develop in the post-measurement reached (8.940) degrees, with an improvement rate of (21.5%).

- **Recommendations:**

- Applying TRX suspension training to develop the technical performance of kip skills understudy.
- The combination of physical and technical training in proportion to the motor paths of the skills required to be developed with the aim of comprehensive preparation of the player, to reach the highest level of achievement.
- Awareness of trainers about the importance and how to apply TRX suspension training, in proportion to the requirements of technical performance on each gymnastics apparatus.
- Applying TRX suspension training in the technical preparation phase and the competition period, to make the most of mastering the technical routine on various gymnastics apparatuses.
- Applying TRX suspension training to different gymnastics apparatuses, and to other age stages.
- Applying TRX suspension training instead of weight training for juniors to avoid injuries.

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