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The effectiveness of a training program using cross-training on certain specific physical abilities and the level of skill performance in gymnastics

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The research aims to design a proposed training program using cross-training and to know its effect on :

1. The level of some physical abilities specific to gymnastics (muscular strength - ability - speed - flexibility - agility - coordination)

2. The level of skill performance on gymnastics equipment (floor apparatus - pommel horse - rings - vaulting table - parallel bars - horizontal bar)

Research method :

The researcher used the experimental method due to its suitability to the nature of the research by using pre- and post-measurement of one group.

The sample was chosen in a deliberate manner with (12) students (7) students as basic samples and (5) students as exploratory sample.

The researcher set some variables that may affect the research experience, namely (growth rates, "age, height, weight", athletic age.

In The light of the procedures and results of the research, the researcher has reached to the following :

1. The cross-training method had a positive effect on the special physical abilities of gymnasts, which are (muscular strength - muscle capacity - speed - flexibility - agility - coordination), and this effect was reflected in the level of skill performance.

2- The training program applied to the research sample showed that the organizational form of the training unit, which includes a group of different activities, devices, tools and exercises that differ from the basic activity (gymnastics), leads to creating a spirit of fun and gives an incentive to continue training with high efficiency,

Keywords: cross-training ,physical abilities ,gymnastics

The effectiveness of a training program using cross-training on certain specific physical abilities and the level of skill performance in gymnastics

Introduction and Research Problem :

Physical preparation is one of the most important components of success in gymnastics, and it is the first step to achieving the highest levels of sports. It is also considered one of the most important pillars on which the gymnast is based to achieve distinguished performance in championships. The special physical preparation aims to develop the necessary physical qualities that distinguish gymnastics and to try to develop them, and to work on developing them to the maximum extent so that the player can reach the highest possible level of technical performance.

Brad Walker (2007) states that cross-training is the use of various activities to achieve comprehensive adaptation in a specialized sport, as it uses various activities to provide relief for the player from the effects of training in the specialized sport, which allows the muscles, tendons, bones, joints and ligaments a short break, and works to achieve muscular balance for the athlete, so cross-training is an effective way for the body to rest from specialized training while maintaining the physical and technical level. (2:28)

Cross-training activities include weight training, plyometric exercises such as box jumps, and ballistic training, which build body strength and develop muscle strength and endurance in the legs and arms. They also include aerobic endurance activities, including water jogging, using the treadmill and stationary training wheel, as well as anaerobic endurance activities, including speed training . (12:30)

Werner & Sharon (2011) add that cross-training is a training method that combines two or more activities in a program. Cross-training works to develop physical fitness and provide the necessary rest for stressed muscle groups, reduce the rate of injury and eliminate monotony in training, as well as reduce the risk of burnout resulting from the phenomenon of overloading athletes. (20:35)

Gymnastics is one of the most difficult sports activities and is considered one of the important and vital sports that require advanced methods and ways to train on it so that the level of performance of the players can be advanced, especially since it is considered one of the basic

sports that contribute to developing the physical qualities and skill capabilities of the player. It requires discovering the most important details of good technical performance of gymnastics skills towards knowing the characteristics and components of these skills and their requirements of special physical qualities that must be available to reach a distinguished level. (1:7)

Ibrahim Diab, Hamdi Wetet (2010) indicate that technical performance in gymnastics requires reaching a level of mastery with certain specifications and precise technical performance, which requires the availability of special training requirements. It also requires the development of the physical qualities necessary for this performance among young people, which requires directing more care and attention to them. (5: 62)

In light of the current efforts to try to raise the technical and skill level in gymnastics, it was necessary to follow the scientific method and thoughtful planning to reach the high levels in gymnastics .

Through the researcher's experience and work as a gymnastics coach, he noticed a decline in the physical level of players and a feeling of boredom within the training units because they follow a uniform routine, which affected the decline in the level of skill performance. The researcher also noticed that most coaches were not interested in using cross-training activities in gymnastics to maintain the training condition in order to reduce the risk of injury for players. This prompted the researcher to think about raising the level of physical and skill performance for gymnasts, as some forms of training units may be characterized by stereotyping that may make players bored, which may not motivate players to continue training efficiently and effectively. To overcome this stereotyping in training, the researcher believes that the training unit should include various exercises and activities. This can be achieved by employing cross-training in the training process to contribute to raising the level of performance, especially with what cross-training contains of various activities such as (climbing stairs - plyometric training, running, weight training, training in the water environment...etc.). Through theoretical readings, the researcher noticed that researchers use cross-training in various sports and the rarity of using cross-training in the field of gymnastics. From here, the researcher saw the need to develop a training program aimed at developing physical capabilities. Special and skill level of performance

in gymnastics using cross-training, which helps training in raising the level of skill performance and reaching the highest sports levels.

Study objectives:

The research aims to design a proposed training program using cross-training and to know its effect on :

1. **The level of some physical abilities specific to gymnastics (muscular strength - ability - speed - flexibility - agility - coordination)**
2. **The level of skill performance on gymnastics equipment (floor apparatus - pommel horse - rings - vaulting table - parallel bars - horizontal bar)**

Hypotheses:

1. **The use of cross-training has a positive effect on the level of physical abilities specific to gymnastics (muscular strength - ability - speed - flexibility - agility - coordination).**
2. **The use of cross-training has a positive effect on the level of skill performance on gymnastics equipment (floor apparatus - pommel horse - rings - vaulting table - parallel bars - horizontal bar) and in favor of dimensional measurements.**

Procedures:

Research method :

The researcher used the experimental method due to its suitability to the nature of the research by using pre- and post-measurement of one group.

Research sample :

The sample was chosen in a deliberate manner with (12) students (7) students as basic samples and (5) students as exploratory sample.

1- homogeneity :

The researcher set some variables that may affect the research experience, namely (growth rates, "age, height, weight", athletic age. Table (1) shows the homogeneity of the research sample.

Table (1)

Homogeneity of the research sample in the basic variables

Variables	unit of measure	mean	deviation	torsion
Length	year	21,15	4.249	1.294
the weight	tall	170,14	4.122	0.67
Age	k.m	68,14	0.396	0.15

Age of training	Training age	3,73	0.376	0.995

Table (1) shows the homogeneity of the research sample in the variables (age, height, weight, training age) under study, as the coefficient of torsion ranges between ± 3, which indicates the homogeneity of the research sample in the variables of age, height, weight and training age, and that it falls within the limits of the curve Equinox.

2- Equivalence:

To achieve parity between the two research groups, the researcher found the significance of the differences between the two groups in the pre-measurement of the tests of the selected variables under consideration, as shown in Table (2).

Table (2)

Equivalence of the experimental and control group in Physical and skill variables n = 7

Variables		unit of measure	deviation	mean	median	torsion
Special physical abilities	Muscular Strength	K.g	36.62	0,49	34.36	1.54
	Muscular Power	c.m	40.53	0,05	38.00	1.05
	Speed	second	5.24	1,48	4.41	0.87
	Flexibility	c.m	27.57	0,82	25.64	1.21
	Agility	second	8.54	1,07	6.83	0.66
	Coordination	K.g	48.24	0.97	46.25	0.57
Skill performance level	floor	degree	7.53	0.59	7.33	1.45
	Horse Ring	degree	4.25	0.68	4.36	0.89
	Ring	degree	5.54	0.66	5.24	1.24
	Vaulting Table	degree	7.24	0.77	7.15	0.52
	Parallel	degree	7.65	0.57	7.35	0.62
	Hanging	degree	6.98	0.65	6.58	1.71

The tabular t value is at 0.05 = 2.571

It is clear from Table (2) that the values of the skewness coefficients for the research sample in the physical and skill variables (under study) ranged between (0.57 - 1.71) they were limited to (±3), which indicates the moderation of the distribution of the individuals of the basic research sample in these variables .

collection tools and means :

1-Tools, equipment and playgrounds used:

The researcher used the following tools, devices and playgrounds to collect data:

- **Multi-height jump boxes.**
- **Swedish benches - Stopwatch.**
- **Restameter device to measure height (cm)**
- **Medical scale to measure weight (kg)**
- **Fitness hall equipped with (treadmill - stationary bike - weight jackets - weight training devices - leg weights (getter(**
- **Men's artistic gymnastics devices**
- **Basketball court and its equipment**
- **Swimming pool**
- **Cones - Sandbags - Hoop jump ladders - Jump ropes - Sponge mattresses - Rubber pads - Medicine balls - Training barriers - Step boxes - Chalk and lime - Sandy ground area.**

2-Measurements and tests used in the research :

Special physical abilities tests in gymnastics. Attached (3)

- **Muscular strength: Inclined prone test, flexed arms**
- **Muscular ability: Standing broad jump test.**
- **Speed: 30m sprint test.**
- **Flexibility: Maximum leg opening test.**
- **Agility: Barrow 3 x 4.75m agility test.**
- **Coordination: Jump rope test.**

Evaluation of technical performance on gymnastics equipment :

The skill performance of the research sample players was measured by a committee of international judges from the Egyptian Gymnastics Federation, who are faculty members in the Department of Exercises and Gymnastics at the college

Survey study :

A survey study was conducted on a sample of (5) individuals from outside the basic sample of the research and from the research community.

The aim of the survey study was to ensure:

- **The validity and sufficiency of the tools and devices used and the recording cards.**
- **The accuracy of conducting and implementing the tests and measurements.**

- **Training assistants to understand the specifications of the tests and measurements used and the methods of measurement and recording.**
- **Coordinating and organizing the workflow in the measurement.**
- **Understanding and awareness of the sample members of how to perform the tests and measurements used.**
- **Conducting scientific transactions for the tests under study.**

1- Honesty :

The researcher used discriminant validity by applying the tests to a distinct sample consisting of (5) players from outside the basic sample and from the research community and a non-distinctive sample consisting of (5) gymnastics students in the Department of Sports Sciences and Physical Activity during the period from 15, 16/1/2024 AD. Table (4), (5) below illustrate this

Table (4)

Significance of differences between the average scores of physical tests for the distinguished and non-distinguished groups (n=10)

Variable	unit of measure	distinctive		non-distinctive		Calculated "t" value
		Mean	Deviation	Mean	Deviation	
Muscular Strength	k.g	36.62	0,49	35.64	0,06	*3,01
Muscular Power	c.m	40.53	0,05	39.56	0,21	*4,26
Speed	second	5.24	1,48	4.57	0,84	*5,25
Flexibility	C,m	27.57	0,82	26.23	0,26	*3,33
Agility	C.m	8.54	1,07	7.25	0,76	*2,89
Coordination	K.g	48.24	0.97	47.25	0,36	*3,64

Table value (t) at level (0.05) = 2.31 *

Table (4) shows that there are statistically significant differences between the distinguished and non-distinguished groups in all physical test scores in favor of the distinguished group, as the calculated (t) values for the physical tests ranged between (2.89: 5.25), which is greater than its tabular value at the (0.05) level, which indicates the validity of the physical tests.

2- Stability:

In order to verify the stability of the tests, the researcher used the application and re-application method (Test.Retest) during the time period 15, 16/7/2023 AD, then these tests were applied for the second time to the same sample during the time period 22, 23/1/2021 AD, with a

time difference of one week between the first application and the second application, and Table (5) shows this .

Table (5)
Correlation coefficients between the first and second application for physical tests (n=7)

Variable	unit of measure	First applied		Second applied		Calculated "r" value
		Mean	Deviation	Mean	Deviation	
Muscular Strength	k.g	36.62	0,49	36.24	0,30	*0,90
Muscular Power	c.m	40.53	0,05	40.57	0,07	*0,89
Speed	second	5.24	1,48	5.89	1,30	*0,92
Flexibility	C,m	27.57	0,82	27.57	0,86	*0,98
Agility	C.m	8.54	1,07	8.78	1,06	*0,90
Coordination	K.g	48.24	0.97	48.69	1,40	*0,96

The table value of (r) at the level (0.05) = 0.36* significant

Table (5) shows that there is a statistically significant correlation between application and reapplication in all physical tests, as the calculated "r" value for the physical tests ranged between (0.89: 0.98), which is greater than the tabular "r" value, indicating the stability of these tests .

Proposed cross-training program: Attached (4) :

- Program objectives :

1. **Developing special physical abilities in gymnastics.**
2. **Improving the level of skill performance on men's artistic gymnastics equipment.**

- Program development principles:

1. **Paying attention to performing stretching and flexibility exercises at the beginning of the training unit.**
2. **The appropriateness of the exercises selected in the training unit with the capabilities of the research sample members.**
3. **Providing an element of diversity and excitement in the activities and exercises used.**
4. **The researcher used the interval training method with its two parts (low and high) intensity during the proposed training program.**
5. **Gradually increasing the training loads in line with the special physical capabilities of the research sample.**

6. **Good standardization of the components of the training load (repetitions - groups - rest period between groups) to avoid the phenomenon of overload.**
7. **Implementing a set of relaxation exercises in the final part of the daily training unit with the aim of returning the body to its normal state.**

- Training program content:

The researcher directed the cross-training activities to develop the special physical abilities and the level of skill performance on gymnastic devices by combining the cross-training activities in order to achieve this goal, where the cross-training activities (weight training - ballistic training - water training) were used in addition to using basketball to achieve enjoyment in training. The content of the training program was divided into three main parts as shown in Table (6)

Table (6)
The three main parts of the proposed training program

Part	Cross training time	Load intensity	Comfort	Cross-training activities used
General Preparation	65 min	Average	Fixed	Weight training - Basketball
Special Preparation	50 min	Above average	Fixed	Weight training - Pool
Integration Phase	35 min	Below maximum	Fixed	Ballistic training - Pool - Basketball

- Parts of the daily training unit :

- **Physical preparation:**

The duration of this part is (15) minutes and is performed by the members of the basic research sample, in order to prepare the circulatory and respiratory systems with a focus on stretching and flexibility exercises.

- **The main part:**

Training is done on gymnastic equipment on the first day: floor apparatus - pommel horse - rings and on the second day: vaulting table apparatus - parallel bars - bar in addition to implementing cross-training activities to develop special physical abilities, which are explained in detail in Annex (4).

- **Conclusion (cooling down):**

The duration of this part is (5) minutes and is performed by all members of the basic research sample, and includes relaxation exercises in the water, calming down and light stretching.

Pre-measurements:

The researcher conducted pre-measurements for the members of the basic research sample in terms of special physical abilities and skill performance level on gymnastics equipment, during the period from 1/15/2023 to 1/17/2024.

Implementation of the training program:

The content of the proposed cross-training program attached (4) was applied to the members of the basic research sample (one group) during the period from 1/18/2024 to 3/17/2024 for a period of (8) weeks, at a rate of (4) training units per week.

Post-measurements:

The researcher conducted post-measurements for the members of the basic research sample during the period from 3/19/2024 to 3/21/2024 with the same order and conditions as the pre-measurements.

Statistical Processes:

The researcher processed the data statistically using the following statistical analysis methods: Mean - Standard Deviation Stdev.- Median - Skewness - Test (T) - Improvement percentage.

View and discuss the results :

First: Showing results: -

Table(7)

The significance of the differences between the pre- and post-measurements of the research sample members in the physical variables under study N = 7

Variables	Unit of measure	Pre		post		T value
		mean	Stdev	mean	Stdev	
Muscular Strength	k.g	36.62	0,49	44.33	3.69	*2.94
Muscular Power	c.m	40.53	0,05	51.90	0.45	*3.51
Speed	second	5.24	1,48	4.10	0.29	*3.74
Flexibility	C.m	27.57	0,82	12.64	1.42	*2.92
Agility	C.m	8.54	1,07	5.80	2.57	*2.59
Coordination	K.g	48.24	0.97	55.36	0.94	*2.33

Table t-value at 0.05 = 2.262 * significant at 0.05 level

Table (7) shows that there are statistically significant differences at the 0.05 level between the pre- and post-measurements of the basic research sample members in the physical variables (muscular strength - muscular ability - speed - flexibility - agility - compatibility) in favor of the post-measurement.

Table (8)

Percentages of improvement in the post-test compared to the pre-test for the research sample members in the physical variables under study

Variables	Unit of measure	Research sample		improvement rate
		pre	post	
Muscular Strength	k.g	36.62	44.33	%21.05
Muscular Power	c.m	40.53	51.90	%28.05
Speed	second	5.24	5.10	%0.26
Flexibility	C.m	27.57	12.64	%52.88
Agility	C.m	8.54	5.80	%32.08
Coordination	K.g	48.24	55.36	%12.86

Table (8) shows that there are improvement rates in the post-measurement compared to the pre-measurement for the research sample individuals in the physical variables under study, ranging between (0.26% - 52.88%) in favor of the post-measurement.

Table (9)

The significance of the differences between the pre- and post-measurements of the research sample members in the level of performance on artistic gymnastics equipment for men, N = 7

Variables	Unit of measure	Pre		post		T value
		mean	Stdev.	mean	Stdev.	
Ground Apparatus	degree	7.53	0.59	9.35	054	*6.17
Pomegranate Horse	degree	4.25	0.68	6.32	035	*5.94
Pomegranate	degree	5.54	0.66	6.58	078	*3.38
Vault Table	degree	7.24	0.77	9.35	0025	5.32*
Parallel Bar	degree	7.65	0.57	9.14	054	55.2*
Hanging Bar	degree	6.98	0.65	8.12	078	33.6*

Table t-value at 0.05 = 2.262 * significant at 0.05 level

Table (9) shows that there are statistically significant differences at the 0.05 level between the pre- and post-measurements of the members of the basic research sample in the level of performance on artistic gymnastics equipment for men in favor of the post-measurement.

Table (10)
Percentages of improvement in the post-test over the pre-test for the research sample members in the performance level on men's artistic gymnastics equipment

Variables	Measure of unit	N = 7		
		pre	post	improvement rate
floor	degree	7.53	9.35	%24.16
Horse Ring	degree	4.25	6.32	%48.70
Ring	degree	5.54	6.58	%18.77
Vaulting Table	degree	7.24	9.35	%38.08
Parallel	degree	7.65	9.14	%19.47
Hanging	degree	6.98	8.12	%16.33

Table (10) shows that there are improvement rates in the post-measurement compared to the pre-measurement for the individuals of the basic research sample in the level of performance on artistic gymnastics equipment for men, as they ranged between (16.33% - 48.70%) in favor of the post-measurement.

Discuss the results

Discussion of the results of the first hypothesis:

The results of Table (7) indicated that there were statistically significant differences at the 0.05 level between the pre- and post-measurements of the basic research sample members in physical abilities (muscular strength - muscle capacity - speed - flexibility - agility - coordination) in favor of the post-measurement.

The results of Table (8) also showed that there were improvement rates in the post-measurement compared to the pre-measurement of the basic research sample members in the physical variables under study, ranging between (0.26% - 52.88%) in favor of the post-measurement.

The researcher attributes this improvement in physical abilities (muscular strength - muscle capacity - speed - flexibility - agility - coordination) among the individuals of the basic research sample to the effectiveness of the content of the cross-training program, which included a set of weight training exercises for the legs, arms and trunk to establish muscle strength (the first stage of the proposed training program) in addition to practicing water training and basketball as a recreational factor somewhat away from gymnastics activity. In the second stage, weight training was implemented at high intensities to ensure the development of the muscle strength of the gymnasts. Then, in the third stage, ballistic training began, in which it was taken into account the standardization of training loads in a manner consistent with the nature of the performance of the gymnasts in addition to practicing water training and basketball.

This result is consistent with the results of the study of Gamal Mahmoud Abdel Khaleq (2020) (3), Hamdi Al-Sayed Abdel Hamid (2012) (4), and Rabie Othman Al-Hadidi (2011) (15) on the importance of using cross-training activities and programs in developing the various physical abilities of athletes.

This result is consistent with what was indicated by Zbeirz, (2010) (23), Maha Mohamed Al-Hijrasy (2007) (10) that cross-training has a high degree of importance in improving the level of physical fitness components through cross-training activities such as swimming, cycling, running, and walking in water, as well as climbing stairs and rowing. Cross-training is not intended to be an activity to replace the training schedule, but rather it is an enhancer of athletic performance, through building muscles and developing coordination, balance, speed, and explosive muscle strength.

Jack Wilmore, et., al (2008) add that cross-training is training in more than one sport at the same time or training different elements of physical fitness such as endurance, muscle strength and flexibility at the same time, where players train with a set of weight training, ballistic, swimming, running and cycling to prepare for sports competitions. (6 : 248)

Thus, the validity of the first research hypothesis is achieved, which states: "The use of cross-training has a positive effect on the level of

physical abilities specific to gymnastics (muscular strength - ability - speed - flexibility - agility - coordination).

Discussion of the results of the second hypothesis:

The results of Table (9) showed statistically significant differences at the 0.05 level between the pre- and post-measurements in the level of skill performance on men's artistic gymnastics apparatus (floor apparatus - pommel horse - rings
- vault table - parallel bars - horizontal bar) in favor of the post-measurement.

The results of Table (10) also indicated that there were improvement rates in the post-measurement compared to the pre-measurement for the research sample members in the level of skill performance on gymnastics apparatus (16.33% - 48.70%) in favor of the post-measurement.

The researcher attributes this progress in the post-measurement compared to the pre-measurement to the effectiveness of using the training program using cross-training, which included diverse and interesting exercises that help improve the physical elements and thus led to a noticeable improvement in the level of skill performance and at clear rates. The cross-training program was based on the foundations and principles of raising the level of athletic achievement, and the following were taken into account when designing the training program: (the correct relationship between load and rest - the relationship between load and adaptation "specificity, overload" - continuity in training - progress in the degree of load - specificity of training - unity between training and preparation periods - individuality in training - evaluation and follow-up).

This is consistent with what was indicated by the study of Muhammad Sami Mahmoud Saeed (2021) (14), Sherine Ali Hassan 2010 (18), which proved the effectiveness of the impact of cross-training on the level of skill performance as a result of its effective role in developing physical abilities, which was positively reflected in the level of skill performance.

Thus, the validity of the second research hypothesis is achieved, which states: "The use of cross-training has a positive effect on the level of skill performance on men's artistic gymnastics equipment."

Conclusions and recommendations

Conclusions

In The light of the procedures and results of the research, the researcher has reached to the following conclusions:

1. **The cross-training method had a positive effect on the special physical abilities of gymnasts, which are (muscular strength - muscle capacity - speed - flexibility - agility - coordination), and this effect was reflected in the level of skill performance.**

2- The training program applied to the research sample showed that the organizational form of the training unit, which includes a group of different activities, devices, tools and exercises that differ from the basic activity (gymnastics), leads to creating a spirit of fun and gives an incentive to continue training with high efficiency, which was reflected in the development of physical competence specific to gymnastics.

Recommendations

Based on the results of the research and the resulting conclusions, the researcher recommends the following:

1. **Urging junior gymnastics team coaches to use cross-training in training programs due to its positive impact on physical and skill variables.**
2. **Conducting similar research aimed at designing standardized training programs using cross-training, in different organizational forms in the field of gymnastics training.**
3. **Applying this study to different samples in terms of age, gender and sports activity.**
4. **Disseminating the concept and importance of cross-training as it is a modern trend in sports training and taking into account the integration of cross-training in the training program for its effective role in developing the components of the physical and skill training condition and raising the level of performance while maintaining the factors of pleasure and joy.**

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