The effect of Pilates training on some physical variables and skill level among young swimmers

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Introduction and research problem:

The level of technical performance in swimming raises surprise and admiration, which confirms that sports training has become primarily dependent on a lot of experimental and human sciences, which have uted to its various applications in increasing the effectiveness and contrib efficiency of the training process, as recent years have witnessed an ، Physical and technical durratexplosion of knowledge in the field of training training methods such as Modern and it has become common to use Training methods aimed at developing and all of them ،Pilates Exercises the physical, technical and psychological aspects of players in swimming to achieve more amazing results in many international, Olympic and .pionshipsinternational cham

The developed countries in the (2010) **Ahmed Alhadi Yousef** Notes field of swimming are interested in planning in preparing the swimming player in a comprehensive and balanced manner, especially the excellence t the new requirements of swimming can be met of physical abilities, so tha (3:on various devices. (291

early onset of training in **points out that the** (2005) Maksoud-Mr. Abdel many sports activities requires that training during childhood and boyhood rch, and that structured physical training be supported by scientific resea must be performed during the course of all ages, especially childhood(5:417)

states that muscular strength is the most **(2003) Adel Abdel Basir** ave important physical characteristic of the swimming player, studies h and the level of growth ،proven a direct relationship between sports results of physical abilities of the swimming player, and since it was known that exercises and swimming movements require different and varied transitions ining the player's body weight as resistance, and movements while mainta which necessitates the need for the player to acquire many physical technical performance abilities associated with.(8:98)

Aagaard & Andersen (2009) add that the player's requirements for strength and endurance vary according to the nature of the activity practiced, some sports need the element of muscular strength to a greater degree than the element of endurance, and others need the element of muscular endurance to a greater degree of muscular strength, and the majority need both elements together to the same degree and importance as swimming players. 2:422)

Pilates training is one of the methods of physical preparation training, which aims to improve muscle strength, and the ability to control performance through the various muscles of the body in general and the trunk muscles in particular through compatibility, and accuracy between both the nervous and muscular systems, as it contributes to the employment of muscle groups through continuous movement in a smooth

manner , Careful emphasis on the strength and balance of the various axonal muscles of the body. 34:318)

Seifert et al**. Seifert (2010) mention a** set of principles for Pilates style training, the first principle is muscular control as the trunk muscles have a major role in the transfer of the motor chain from the bottom up and vice versa, and thus develop the level of skill performance, the second principle of focus aims to compatibility between muscle training, and mental focus together where it leads to an increased sense of movement performed by the individual during the performance of the exercise, While the principle of centralization aims to transfer movement from the trunk area to the rest of the body. The principle of accuracy means performing correctly, and the principle of fluidity is the performance of movement sequentially without fragmentation, while the principle of breathing aims to regulate the rhythm of movements. (33:132)

Carter (2011) points out that Pilates training is characterized by its ability to develop muscle strength without the appearance of bulkiness of the muscles of the different body, and without the apparent increase of the physiological section of the muscles, thus giving a better shape and texture to the body. (27:291)

Trunk stability exercises are the main key to training programs for athletes for all levels, where the trunk muscles act as a bridge that connects the upper limb, and the lower limb of the body, and usually the force caused by the trunk is called the source of energy for the limbs, and for the initial stability of the body occurs, it needs to develop the muscles surrounding the spine.24:56)

Dean **(2003) *points out*** *that the trunk and pelvis area include the abdominal muscles***, the muscle group of the back region***, and the muscle group of the groin area as these muscle groups are*** **responsible for achieving stability for the spine area** *and trunk area, and the main muscles of each of the muscles of the legs are also connected , The shoulder and arms are in the central part of the body, where they help improve the technical performance of athletes. 26:67)*

Swimming is one of the sports that is characterized by a special character in terms of the multiplicity of its devices, and its practice requires the availability of special fitness elements to reach high-end technical performance.

Mohamed Shehata (1997), Adele Shenouda and Samia Farghaly (1999) **agree** that the swimming player needs physical qualities and abilities, distinguishing him from other individual sports players, because of the difficulties and high-level technical performance of swimming, and challenging the player's abilities, which requires him to have distinctive physical potential, especially the muscle strength component, which is the most important physical characteristic of the swimming player and its direct relationship to the level of technical performance. 13:291)(4:61)

The researcher has noted by reviewing the reference studies related to the subject of the research, such as the study of: **Park et al., (2016)(31)**, Nasser Mohamed (2019) (20), Hussein Abdel Wanis (2020) (6), Mohamed Helmy (2020)(17), Montaser Bakhit **(2020) (19)**, **Rehab Ahmed (2022) (7), Noureddine Mohamed (2022) (21)** showed the effectiveness of Pilates training programs in developing the physical abilities and level of skill performance of athletes, but these scientific studies - to the best of the researcher's knowledge - did not address identifying the effectiveness of the Pilates method using trunk stability exercises on some physical variables and the level of performance of basic motor skills for swimming beginners.

Also, through the experience of the scientific and applied researcher in the training of junior swimming at Cairo Sports Club, he noticed a low level of technical performance for some basic motor skills in swimming at Cairo Sports Club **, and the researcher also**

noted through friction with many swimming coaches that there are some coaches who do not give enough time for Pilates training during the period of special preparation, or diversity in the exercises Physical, and therefore bored juniors of the rigidity of the training unit, all this contributed to the poor level of technical performance of beginners in swimming Cairo Sports Club.

Therefore, the researcher conducted this research to identify the effectiveness of the Pilates method using trunk stability exercises on some physical variables and the level of performance of basic motor skills for swimming beginners.

Research Objective:

This research aims to develop a training program using Pilates training for junior swimming from (5-6) years and to know its impact on the following:

1- Special physical abilities (muscular ability of the legs – muscular ability of the arms – endurance of the strength of the arms – bearing the strength of the abdominal muscles – flexibility of the trunk and back) for swimming beginners.

Research hypotheses:

1 - There are statistically significant differences between the pre- and post-measurements of the members of the basic research sample in the special physical abilities (muscular ability of the legs – muscular ability of the arms – endurance of the strength of the arms – endure the strength of the abdominal muscles – flexibility of the trunk and back) in favor of the dimensional measurement.

2 - There are statistically significant differences between the pre- and post-measurements of the members of the basic research sample ***in the***

level of swimming crawling on the abdomen in favor of the dimensional measurement.

Terms used in the research:

Pilates Exercise:

It is an integrated program to train the muscles of the body through the performance of exercises and movements whose main goal is to develop and increase the strength of the trunk muscles in particular, such as the abdominal muscles, back and pelvic joint muscles, which are responsible for muscle control and stability to improve the position, balance and coordination of the body.(32:216)

Trunk stability:

It is "a group of muscles that work to bring stability and stability to the abdomen, back and thigh area to perform the skill efficiently." (29: 105)

Search Procedure:

Research Methodology:

The researcher used the experimental method for its suitability to the nature of this research, following the experimental design of one group using pre-dimensional measurements.

Research population and sample:

The entire research community was selected, namely beginners at the swimming school at Cairo Sports Club, who are between the ages of (5-6) years in the training season (2022/2023), and their number is (19) beginners, and the researcher has selected the basic research sample in a deliberate way, with a strength of (10) beginners with a percentage of (52.63%), and (9) beginners were selected for the survey study from the research community and outside the basic sample, in order to legalize the tests under research.

Moderation of the distribution of the research sample:

The researcher calculated the moderation of the distribution of the members of the research sample in some variables (growth rates - special physical abilities - the ***level of performance of some basic skills in swimming***), and tables (1), (2), (3) illustrate this.

Table (1)

Moderation of the distribution of the members of the research sample in growth rates (age, height, weight and training age) n = 19

Variables	Unit of measurement	Torsion coefficient	Broker	Standard deviation	Arithmetic mean
Age	**Year**	**0.76**	**5.10**	**0.79**	**5.30**
Total body length	**Poison**	**0.90**	**118.00**	**6.15**	**119.84**
Weight	**Kg**	**0.78**	**19.00**	**4.82**	**20.26**
Training age	**Year**	**0.83**	**0.85**	**0.36**	**0.95**

It is clear from Table (1) that the values of the torsion coefficients in the growth rates (age, height, weight, training age) were limited to (±3), which indicates that the members of the research sample represent a moderate population in these variables.

Table (2)

Moderation of the distribution of members of the research sample in Special physical abilities under consideration n = 19

Variables	Unit of measurement	Torsion coefficient	Broker	Standard deviation	Arithmetic mean
Muscular ability of the legs (vertical jump)	**poison**	**0.82**	**20.00**	**4.61**	**21.26**
Muscular ability of the legs (broad jump)	**poison**	**0.69**	**100.00**	**12.19**	**102.79**
Muscular capacity of the arms	**meter**	**0.85**	**2.00**	**0.53**	**2.15**
Tension up	**number**	**0.72**	**10.00**	**4.81**	**11.16**
Sitting from lying down	**number**	**0.57**	**20.00**	**5.29**	**21.00**
Thigh and trunk elasticity	**poison**	**0.78**	**8.00**	**3.42**	**8.89**
Flexibility of the spine (arching back)	**poison**	**0.66**	**44.00**	**7.18**	**45.58**

Illustrated from the table number (2) that all Values Sprain coefficients For special physical abilities The subject of research was limited to (± 3) Which indicates that the members of the research sample represent a moderate population in these variables.

Data collection tools:

First: Physical tests under research: Appendix (1)

By informing the researcher of the scientific references specialized in swimming and measurement, such as: **Mohamed Shehata Mohammed Breig (1995))(15)، Adly Hussein (1998)10)،Allawi Mohamed Nasr Eddin Radwan (2001) (16) ، Mohammad Sobhi (2003))(18)،** Ibrahim Salameh (2005) (1)، Abdel Moneim Suleiman (2007) **(9)** Physical tests that measure Special physical abilities affecting the level of technical performance of the skills under research as follows:

1- Vertical jump test of stability.

2- Wide jump test of stability.

3- Medical ball push test (1) kg.

4- Tensile test for the highest rate.

5- Sitting test from lying down with the knees bent.

6- Test the bending of the trunk forward from standing.

7- Test the bending of the trunk back from standing.

Third: Tools and devices used in the research:

- Rastamir device to measure the total length of the body (cm).
- Medical scale calibrated to measure weight (kg).
- Hall with its training tools.

Scientific transactions (truthfulness - stability) for the tests under research:

First: Honesty Coefficient:

To calculate the honesty coefficient, the researcher applied the physical tests under research to the members of the survey sample (a group that is not distinguished skillfully) and their number is (9) beginners, and the same tests were applied to another sample and their number (9) beginners as a skillfully distinguished group from Heliopolis Club, The significance of the differences between The two distinct and unmarked groups, and Table (4) illustrates this.

Table (4)

Significance of the differences between distinct and non-distinct groups

In the physical tests under research

Tests	Unit of measurement	Value "T"	Unmarked group n = 9		Featured set n = 9	
			on	M	on	M
Muscular ability of the legs (vertical jump)	poison	2.51*	3.96	20.80	3.12	25.25
Muscular ability of the legs (broad jump)	poison	2.48*	5.12	102.00	5.04	108.30
Muscular capacity of the arms	meter	2.54*	0.27	2.10	0.30	2.45
Tension up	number	3.63*	3.29	10.33	2.82	15.89
Sitting from lying down	number	3.89*	3.77	20.56	3.01	27.22
Thigh and trunk elasticity	poison	3.08*	2.31	8.44	2.16	11.89
Flexibility of the spine (arching back)	poison	2.84*	4.29	42.00	3.53	47.56

Tabular value of "T" at the level of 0.05 = 2.120 * D at the level of 0.05

It is clear from Table (4) that there are statistically significant differences at the level of (0.05) between the two distinct and non-distinguished groups in the physical tests under consideration in favor of the skillfully distinguished group, which indicates the validity of these physical tests for what they were developed for.

Second: Stability Coefficient:

The researcher calculated the stability coefficient for the physical tests under research by applying and returning it to the members of the survey sample with an interval of (5) days, and the simple correlation coefficient was found between the first and second applications, and Table (5) illustrates this.

Table (5)
Stability coefficient for the physical tests under consideration n = 9

Tests	Unit of measurement	Value "T"	Second application		First application	
			on	M	on	M
Muscular ability of the legs (vertical jump)	poison	0.825*	3.71	21.56	3.96	20.80
Muscular ability of the legs (broad jump)	poison	0.803*	5.29	105.00	5.12	102.00
Muscular capacity of the arms	meter	0.861*	0.31	2.22	0.27	2.10
Tension up	number	0.849*	3.42	11.00	3.29	10.33
Sitting from lying down	number	0.811*	3.59	21.33	3.77	20.56
Thigh and trunk elasticity	poison	0.835*	2.26	9.00	2.31	8.44
Flexibility of the spine (arching back)	poison	0.801*	4.02	43.44	4.29	42.00

Tabular value of "t" at the level of 0.05 = 0.666 * D at the level of 0.05

It is clear from Table (5) that there is a statistically significant correlation at the level of (0.05) between the results of the first and second applications of the physical tests under research, which indicates the stability of these tests.

Proposed Pilates Training Program:

Objectives of the proposed Pilates Training Program:

1- Developing special physical abilities (muscular ability of the legs – muscular ability of the arms – bearing the strength of the arms – bearing the strength of the abdominal muscles – flexibility of the trunk and back) for swimming beginners from (5-6) years.

Principles for the development of the proposed Pilates training program:

1- Perform each training in a calm and controlled manner.

2- Using the undulating method in forming the intensity of the load of the exercises used and not using a fixed method in the intensity of the load.

3- Taking into account the use of the method of interval training, both high and low, in the technicians of the training loads in the proposed program.

4- Gradient exercise from easy to difficult and from simple to complex with gradual increase in the intensity of the exercise load during the implementation of the program.

5- Taking into account the continuity and continuity of the process of breathing and exhaling in the stage of effort, and there is no stage in which breathing must be muted.

6- Providing the capabilities and tools used in the program.

7- Pilates training time ranges from (120:60s), repetitions from (4:2), and rest period from (30:60s).

8- Ensure that the practice environment is calm and the place is safe and free of obstacles.

9 – The element of suspense is available in the exercises, as they include exercises without tools – tools – from stability – from movement.

10- Using the principle of positive rest between training groups.

Pre-measurements:

The researcher made the tribal measurements of the members of the basic research sample in the special physical abilities and the level *of the technician in swimming* from 12/5/2022 to 14/5/2022.

Application of the proposed training program:

The content of the proposed Pilates training program (Appendix 5) was applied to the members of the basic research sample for a period of (8) consecutive weeks at the rate of (3) training units per week, from 17/5/2022 to 11/7/2022 at Cairo Sports Club.

Dimensional measurements:

The researcher made dimensional measurements for the members of the basic research sample In special physical abilities and level *Perform some basic motor skills in swimming* During the period from 13/7/2022 to 15/7/2022.

Statistical methods under consideration:

The researcher used the following statistical methods:

- *Arithmetic mean.*	**Mean**
- *Standard deviation.*	**Standard Deviation**
-*Broker.*	**Mediain**
- *Torsion coefficient.*	**Skewness**
- *Simple correlation coefficient.*	**Correlation Cofficients**
- *Test "T".*	**T.Test**
- *Improvement rates.*	**Progress Ratios**

Presentation and discussion of results:

First: Presentation of results:

Table (6)
The significance of the differences between the pre- and post-measurements of a sample Basic research in special physical abilities under consideration n=10

Variables	Unit of measurement	Value "T"	Telemetry		Pre-measurement	
			On	M	on	M
Muscular ability of the legs (vertical jump)	poison	3.18*	3.04	25.00	3.29	21.00
Muscular ability of the legs (broad jump)	poison	2.93*	5.92	108.60	5.20	101.50
Muscular capacity of the arms	meter	2.71*	0.30	2.45	0.35	2.10
Tension up	number	3.54*	2.91	15.70	3.16	11.00
Sitting from lying down	number	3.38*	3.25	26.40	4.03	20.90
Thigh and trunk elasticity	poison	2.93*	2.63	11.70	3.11	8.50
Flexibility of the spine (arching back)	poison	2.66*	3.91	49.20	5.25	44.30

Tabular value of "T" at the level of 0.05 = 2.262 * D at the level of 0.05

It is clear from Table (6) that there are statistically significant differences at the level of 0.05 between the pre- and post-measurements of the members of the basic research sample in the special physical abilities under research in favor of the post-measurement.

Table (8)
Rates of improvement of telemetry from the tribal for the members of the research sample
Basic in special physical abilities under research

Variables	Unit of measurement	One group n = 10		
		Pre-measurement	Telemetry	Improvement rates
Muscular ability of the legs (vertical jump)	poison	21.00	25.00	19.05%
Muscular ability of the legs (broad jump)	poison	101.50	108.60	6.99%
Muscular capacity of the arms	meter	2.10	2.45	16.67%
Tension up	number	11.00	15.70	42.73%
Sitting from lying down	number	20.90	26.40	26.32%
Thigh and trunk elasticity	poison	8.50	11.70	37.65%
Flexibility of the spine (arching back)	poison	44.30	49.20	11.06%

It is clear from Table (8) that there are improvement rates for the dimensional measurement of the tribal for the members of the basic research sample in the special physical abilities under research ranged between (6.99% - 42.73%).

Second: Discussion of the results:

A- Discussing the results of the first hypothesis:

The results of Table (6) and Figure (1) indicated that there were statistically significant differences at the level of 0.05 between the pre- and post-measurements of the members of the basic research sample in the special physical abilities under research in favor of the post-measurement.

The researcher attributes the improvement in the special physical abilities under research to the effective positive impact of the content of the Pilates training program using trunk stability exercises, which included a set of graded, codified and varied exercises through fixed exercises and mobile exercises, and exercises with impressive tools, and others without tools, in which the exercises were performed through mobile muscle contraction, and fixed muscle contraction For the muscles surrounding the trunk area, all this led positively to the development of muscular capacity of the legs and arms and the bearing of strength for the arms, and the bearing of strength for the abdominal muscles and the flexibility of the trunk and thigh, and this result is consistent with what she indicated: Liza & Marie **(2006) (28)** Pilates training has many and varied benefits, as it works to improve muscle tone, in addition to the development of abdominal muscles, which in turn affects the muscular control of the trunk and also works to prevent injury, as well as relaxation, in addition to increasing the range of motion of the various joints of the body, and improving the level of muscle compatibility for athletes.

This result is also consistent with the results **of the study of: Park et al., (2016) (31), Nasser Mohamed (2019) (20), Hussein Abdel Wanis (2020) (6), Mohamed Helmy (2020)(17), Montaser Bakhit (2020)**(19), **Noureddine Mohamed** (2022) (21**)** on the effectiveness of Pilates in developing the physical abilities of individual and team sports players.

Cruz et al.**, (2018)(25)** confirm that Pilates training is characterized by the participation of many different muscle groups and works at various motor levels, and therefore requires a high level of balance and motor stability due to its dependence on the combination of performance between muscle groups that are intended to be developed through the use of synchronization. And compatibility between the muscles involved in performance, which requires the activation of the muscle groups of the trunk so that performance can be controlled well.

Thus, the validity of the hypothesis of the first research, which states: "There are statistically significant differences between the pre- and

post-measurements of the members of the basic research sample in the special physical abilities (muscular ability of the legs - muscular ability of the arms - endurance of the strength of the arms - bearing the strength of the abdominal muscles - flexibility of the trunk and back) in favor of the post-measurement."

Conclusions:

In light of the research procedures, the basic sample limits and statistical analysis, the researcher was able to reach the following conclusions:

1- The training program using Pilates method using trunk stability exercises has a statistically significant positive effect at the level of (0.05) on the special physical abilities (muscular ability of the legs - muscular ability of the arms - endurance of the strength of the arms - endurance of the strength of the abdominal muscles - flexibility of the trunk and back) for swimming beginners from (5-6) years.

2- The Pilates training program using trunk stability exercises positively affects the level of performance of crawling swimming on the abdomen in swimming ***beginners from (***5-6) years.

3- The existence of improvement rates for the measurement of the distance from the tribal members of the basic research sample in the special physical abilities under research ranged between (6.99% - 42.73%).

4- The existence of improvement rates for the measurement of distance from the tribal members of the basic research sample ***in the level of performance of swimming crawl on the abdomen in swimming*** beginners ranged between (74.42% - 84.62%).

Recommendations:

Within the limits of the research sample and its findings, the researcher recommends the following:

1- Using Pilates training because of its effective impact on improving the special physical abilities and the level of performance of some basic skills ***for beginner swimming from (***5-6) years.

2- Developing special physical abilities during the period of physical preparation for the use of Pilates exercises because of their positive impact on the ***level of technical performance*** of swimming beginners.

3- Educating swimming coaches about the importance of "trunk stability training" and providing sports tools and devices in sports clubs.

4- Conducting similar studies on other skills and devices and different age stages using the Pilates method using trunk stability exercises.

References

First: Arabic References:

1- Ibrahim Ahmed Salama (2005): Applied Approach to Measurement in Fitness, Knowledge Foundation, Alexandria.

2- Abu Ela Ahmed Abdel Fattah, Mohamed Hassan Allawi (2005): Physiological foundations of sports training, Dar Al-Fikr Al-Arabi, Cairo.

3- Ahmed El-Hadi Youssef (2010): Methodological Methods in Swimming Education and Training, Dar Al-Maaref, Alexandria.

4- Adele Saad Shenouda, Samia Farghaly (1999): Artistic Swimming (Concepts - Applications), Thought Forum, Cairo.

5- El-Sayed Abdel-Maqsoud (2005): *Sports Training Theories "Force Training and Physiology", Al-Kitab Center for Publishing, Cairo.*

6- Hussein Abdel Ounis (2020): "The Effect of Pilates Training on the Physical and Skill Level of Students of Exercise and Sports Performances", Scientific Journal of Physical Education and Sports Sciences, Volume (88), Part (3), Faculty of Physical Education for Boys, Helwan University.

7- Rehab Ahmed El-Feki (2022): " The effectiveness of the Pilates exercise program on teaching some offensive skills in basketball to second-year students, Faculty of Physical Education in Mansoura", Master's thesis, Faculty of Physical Education, Mansoura University.

8- Adel Abdel Basir Ali (2003): Theories and Scientific Foundations in Modern Swimming Training, Part I, Dar Al-Fikr Al-Arabi, Cairo.

9- Abdel Moneim Suleiman Barham (2007): Encyclopedia of Modern Swimming, Dar Al-Fikr for Publishing and Distribution, Amman, Jordan.

10- Adly Hussein Bayoumi (1998): Artistic Collections on the Earth Movements Apparatus, Dar Al-Fikr Al-Arabi, Cairo.

11- Ezzat Mahmoud Al-Kashef (2003): Training in swimming, the Egyptian Renaissance, Cairo.

12- Ali Al-Beik (2010): Foundations of preparing football players and team games, 2nd Edition, Al-Tony Press, Alexandria.

13- Mohamed Ibrahim Shehata (1997): Modern Swimming Guide, Knowledge Facility, Alexandria.

14- Mohamed Ibrahim Shehata (1998): Ground Swimming Guide, Technical Printing and Publishing, Alexandria.

15- Mohamed Ibrahim Shehata, Mohamed Gaber Bariq (1995): Guide to physical measurements and motor performance tests, Knowledge Foundation, Alexandria.

16- Mohamed Hassan Allawi, Nasr al-Din Radwan (2001): Motor Performance Tests, 3rd Edition, Dar Al-Fikr Al-Arabi, Cairo.

17- Mohamed Helmy Ahmed (2020): "The effect of Pilates training on some physical variables and physiological efficiency of the respiratory circulatory system among competitors (1500 m) run", Scientific Journal of Physical Education and Sports Sciences, Volume (88), Part (5), Faculty of Physical Education for Boys, Helwan University.

18- Mohamed Sobhy Hassanein (2003): Measurement and Evaluation in Physical Education and Sports, Part 2, 5th Edition, Dar Al-Fikr Al-Arabi, Cairo.

19- Montaser Bakhit Hamed (2020): "The effect of Pilates training in improving special physical abilities and the digital level of junior 100 m sprint", PhD thesis, Faculty of Physical Education for Girls, Alexandria University.

20- Nasser Mohamed Shaaban (2019): "The Effect of Pilates Training on Some Physical Variables and the Digital Level of Butterfly Swimming in Aswan Governorate", Assiut Journal for Sports Sciences and Arts, Issue (48), Part (3), Faculty of Physical Education, Assiut University.

21- Nour El-Din Mohamed Mahmoud (2022): "The effect of Pilates training on improving physical abilities and the level of performance of the semicircular kick with the front foot for junior kumate", Master Thesis, Faculty of Physical Education for Girls, Alexandria University.

Second: Foreign References:

22-Aagaard, P., & Andersen, J. ,(2009): Effects of strength training on endurance capacity in top-level endurance athletes, Scand J., Med Sci., Sports, 20 (Supp 1.2):p., 39-47.

23-Alycea, U., (2015): 15 minute everyday Pilates, USA**:** Dorling Kindersley.

24-Bliss , Lisa S : (2005) : Core Stability : The Centerpiece of any Training program", American College of Sports Medicine .

25-Cruz, T., Germano, M., Alex Harley Crisp, A., Sindor, M., Verlengia, R., Mota, G. & Lopes, C. (2018): Does Pilates Training Change Physical Fitness in Young Basketball Athletes?. Journal of Exercise Physiology, 17(1),p.,1-9.

26-Dean & Greg (2003): Stronger ABS and Back ", Human Kinetics , USA .

27-Karter, K., (2011): The complete IDIOT'S guide to the Pilates method, Indianapolis : Alpha books.

28-Lisa & Marie (2006): The effectiveness of Pilates training in healthy adults: An appraisal of the research literature Journal of Bodywork and Movement Therapies, Vol., 11 (2): P., 106-110.

29-Ludmila M.cosio , Lima, Katy, L.Reynolds, Christa Winter, Vincent, Paolone and ,Margaret T.jones (2003): Effects of physioball and conventional floor exercises on early phase adaptations in back and Abdominal core stability and balance in women, , J Strength Cond Res.,vol.,17,(4):p.,721-725.

30-Nelson (2004): The effect of Isometric contrition time on rang of motion, Sports medicine &physical fitness, torino, Italy, p., 49-52, Sep.

31-Park, J., Hyun, G., & Jee, Y., (2016): Effects of Pilates core stability exercises on the balance abilities of archers. Journal Exercise Rehabilitation, 12,(6),p., 553-558.

32-Romani-Ruby, C., & Reuter, B., (2016): Front, long Stretch & Hundred Exercises on the Pilates Reformer & Mat. Journal of Orthopaedic & Sports Physical Therapy, 30,(2),p., 215-226.

33-Seifert, L., Delignieres, D., Boulesteix, L., & Chollet, D.,(2010): Effect of Expertise on Buttery stroke Coordination. Journal of Sports Sciences, 25,(2),p., 131 – 141.

34-Sekendiz, B., Altun, O., Korkusuz, F. & Akın, S. (2007): Effects of Pilates exercise on trunk strength, endurance and flexibility in sedentary adult females. Journal of Bodywork & Movment Therapies, 11,(4),p., 318-326.

35-Tom seaborne (2002): Flexibility stretching PNF al Ballistic Stretch reflex Golgl tendon organ, American college of sports Medicine.