

Effect of Pilates training program on Powerhouse muscles and level performance in Gymnastics

***Dr/ Eman A. Elaassar**

Introduction

Physical education is one of the fields that aim to develop and promote the individual through motor and sports activity in order to establish a good citizen able to realize and create. To reach this goal, it is necessary to adopt a scientific method as a starting point towards the world championships and the principal base for new achievements.

Sports in general and Gymnastics in particular have got recently massive development, increasing their association with the other sciences such as physiology, anatomy, education, biological mechanics and sportive psychology.

A successful training process is based on the ability of the coach in talking care about the nature and the characters of the athletes. He should also use the methods realizing the précised goals for the sportive preparation phases which ensure the balance

between the different issues of the individual and the nature of sportive prepared activities. (Esam2003) & (Hedayt et al. 2008).

One of the new training method is known by (Pilates training), created by Joseph H .Pilates. The integrity of this method is found in six basic principles: concentration, control, centering, precision, flowing movement, and breathing(marie2012)(Josef 2004)

Pilates is based on the philosophy of unified body and mind. It can help athletes at any level to improve mind/body connection, increase performance level and maintain health and physical fitness (karrie2004) (steinhofer2003).

Pilates exercises originate by The Powerhouse which includes; abdominal muscles, lower back and buttocks. The Powerhouse is a band of muscles around the

* Assistant prof, Department of Rhythmic and Artistic Gymnastics Training, Faculty of physical Education, Helwan University, Egypt

Center of the Body (karrie et al 5,6).

Coaches and athletes must pay more attention to this area of the body. So the Powerhouse should be first strengthen before focusing on the arms and legs (Tudor 1999)

Whole torso that workout strengthens the Abc and back and also straightens your posture Can help to build the body to prevent injury and help to keep us healthy through the development of good posture (Michael.K 2001) (Karon.k 2012).

Pilates is part explosive power and part endurance, the combination of which gives both strength and grace for powerhouse and stretch erector spinal and it improve mental outlook and increase motivation, less pain and stiffness (Denise .W 2002)

Artistic gymnastics is a highly skilled sport that requires high levels of conditioning. Consequently, gymnasts are among the strongest and most flexible of all athletes, as demonstrated by their ability to control bodily movements through a variety of positions (Claessens et al 1999).The Powerhouse (the core) provide a stable platform

in order to help control these movements (Willson et al 2005).

The floor exercise is considered as the main foundation for the exercise of gymnastics. It also works on promoting the fitness level of the gymnastics, which contributes to the ease of performance on different devices (Barham 1995) (Adly 2001).

And through the work of the researcher in the training of gymnastic women in Montreal, Canada, she found out weakness in the performance of artistic and aesthetic floor exercise, without maintaining the integrity and balance of the body. According to the researcher, this problem is due to the powerhouse weakness. Through reading previous studies conducted in Pilates exercises, in order to identify the effectiveness of these exercises on the psychological, physiological and physical fitness of some sports and rehabilitation, there is a lack of studying of Pilates in gymnastics for young female gymnastics. Hence, the idea of this study is to identify the impact of Pilates training on the powerhouse to improve the

performance and maintain the integrity of the posture after performing the floor exercise for young female gymnastics.

The search aim

Identify the effect of Pilates training on:

- Powerhouse (core)
- performance level in Gymnastics

Hypotheses

1. There is a significant difference between pre/post test in physical fitness test for Powerhouse between the two groups (experimental, control group) in favor of post measurements.

2. There is a significant difference between pre/post test in level performance for gymnastics between the two groups (experimental, control group) in favor of post measurements.

3. There is a significant difference between two groups (experimental, control group) in physical fitness test for Powerhouse and performance level in gymnastics in favor of post measurements.

Method

Society and sample of Research

Sixteen (16) female gymnastics under (10) years, from Dynamo club, Montreal, Canada. Participants were

divided by two equal groups. First group (experimental) was subject to Pilates training program, and the second group was subject to usual training program.

Measures

This study was proposed to investigate the effect of Pilates training program for eight weeks (from 2/3/2015 to 24/4/2015), on Powerhouse (core) with some physical parameters improvement including; strengthen and endurance Abdominal muscle (degree) by curl up test, Flexibility (cm) Stand and reach test, Static flexibility test for trunk and neck, Balance (sec) by one leg test, and level performance (degree) judged by experts on floor exercises.

Exercise protocol design

Subjects were subjected to specialized **Pilates** program for 8 weeks at intensity 60 - 75% 1hr: 30min 3 days/week. The training session was partitioned into 5 min for warming up, 10- 20 min for the Pilates training, 1hr Gymnastics exercise and 5 min for active cool down. Repetition one complete movement of particular exercise. Set a group of

repetitions performed in sequence.

The subjects spend at least one minute with each exercise,

doing about 5 -10 slow repetition with breathing exhale & inhale, 10 second rest between each exercise .

Table (1)
Training program session

Week	Intensity	No exercise	repetition	Sets	Interval
1-2	60%	9	5-10	1	10sec
3-4	65%	13	5-10	1	10sec
5-6	70%	15	5-10	1	10sec
7-8	75%	18	5-10	1	10sec

Statistical analysis:

A Computer program (SPSS version 21) was used to analyze obtained data. Data expressed as Student's Mean, standard deviation while Wilcoxon Sign Ranks Test were used to examine the difference between baseline and after exercise measurements before and after the proposed program.

Probability was assigned significant at < 0.05 .

RESULTS

Table (2) represents the anthropometric results of both groups. There are no any significant differences in all parameters indicating homogeneity of all students participated in this study. Skewness was found between +3 : -3.

(Table 2)

Anthropometric parameters (Mean \pm SD) for all investigated female gymnastics

Items	Mean	Std. Deviation	Skewness
Age (years)	10.00	0.21	0.285
Height (c . m)	1.449	2.68	0.089
Weight (kg)	35.21	1.11	0.008

When both groups subdivided into two random groups, there anthropometric physical fitness

test and level performance parameters were compared and found to have no significant

differences in-between, them (Table 3).
indicating homogeneity of

(Table3)

Comparison between Anthropometric, physical fitness test and level performance parameters (Mann – Whitney)test for all female gymnastics

Items	Tests	Experimental		Control		Test (U)		
		Mean	Mean Rank	Mean	Mean Rank	Z	P	
Anthropometric test	Age (years)	10.21	5.12	10.25	5.15	0.404	0.680	Ns
	Height (cm)	1.415	0.58	1.410	0.56	0.312	0.591	Ns
	Weight (kg)	34.61	14.39	34.58	14.69	0.414	0.695	Ns
physical fitness test(Powerhouse)	Curl Up test(degree)	11.67	5.12	11.65	5.17	0.328	0.657	NS
	Stand and reach test(cm)	14.15	1.11	14.18	1.02	0.445	0.523	NS
	Static flexibility test for trunk and neck (cm)	16.28	1.16	16.21	1.17	0.418	0.527	NS
	One leg test(sec)	7.48	2.09	7.58	2.11	0.412	0.417	NS
level performance	handstand(degree)	2.10	0.48	2.11	0.52	0.398	0.765	NS
	Front roll(degree)	2.14	0.61	2.17	0.59	0.412	0.754	NS
	cartwheel(degree)	2.61	0.52	2.62	0.54	0.511	0.741	NS
	Hand spring(degree)	2.11	0.51	2.12	0.14	0.444	0.680	NS
	backward(degree)	2.14	0.17	2.15	0.11	0.417	0.711	NS
	Dance element (degree)	2.18	0.44	2.21	0.48	0.384	0.761	NS

< 0.5 statically significant

These results were compared in table (4) using Wilcoxon test non-parametric independent sample differences in physical fitness (Powerhouse). Experimental group was compared to control

group before and after the training program. All results revealed significant difference for Experimental group but no significant for control group after program.

(Table 4)

Physical fitness (Powerhouse) results of the investigated female gymnastics before and after the training program

Items	Experimental				Control				
	Mean rank	Z	P		Mean rank	Z	P		
Curl Up test	before	2	3.521	0.001	S	2	2.174	0.0014	NS
	after	4				3			
Stand and reach test	before	2	3.265	0.009	S	2	2.624	0.0016	NS
	after	4				3			
trunk and neck test	before	2	3.14	0.001	S	2	2.124	0.0011	NS
	after	4				3			
One leg test	before	2	3.214	0.009	S	2	2.521	0.0041	NS
	after	4				3			

< 0.5 statically significant

These results were compared in table (5) using Wilcoxon test non-parametric paired sample differences. Experimental group was compared to control group before and after the training

program. All results revealed significant differences in level performance for the two groups before and after the training program, but the change rate experimental group is bigger than control group.

(Table5)
level performance results of investigate female gymnastics before and after the training program

Tests	Experimental						Control				
	Mean rank	Z	P		Change%	Mean rank	Z	P		Change%	
handstand	Before	2	3.521	0.001	S	109%	2	2.174	0.0014	S	35%
	After	4					3				
Front roll	Before	2	3.652	0.009	S	95%	2	2.624	0.0016	S	23%
	After	4					3				
cartwheel	Before	2	3.14	0.001	S	62%	2	2.124	0.0011	S	2%
	After	4					3				
forward	Before	2	3.214	0.009	S	110%	2	2.521	0.0041	S	48%
	After	4					3				
backward	Before	2	3.145	0.002	S	110%	2	2.219	0.0018	S	44%
	After	4					3				
Dance element	Before	2	3.015	0.002	S	108%	2	2.117	0.0141	S	40%
	After	4					3				

< 0.5 statically significant

These results were compared in table (6) using Mann – Whitney (U) test non-

parametric paired sample differences. Experimental group was compared to control

group after the training program. All results revealed significant differences between the two groups after program. Improvement was higher in

experimental group including physical fitness test (Powerhouse) and level performance.

(Table6)

Mann – Whitney(U)test between physical fitness test(Powerhouse) and level performance for all female gymnastics after the training program

Items	Tests	Experimental		Control		Test (U)		
		Mean	Mean Rank	Mean	Mean Rank	Z	P	
physical fitness test(Powerhouse)	Curl Up test(degree)	15.21	5.14	11.21	5.15	3.621	0.0014	S
	Stand and reach test	18.20	3.80	15.50	3.10	3.265	0.0023	S
	trunk and neck test	18.56	3.05	16.18	3.10	3.412	0.0015	S
	One leg test	10.70	5.50	8.80	4.25	3.214	0.0025	S
level performance	handstand	4.40	2.101	2.85	1.125	3.214	0.0020	S
	Front roll	4.18	1.52	2.69	1.20	3.265	0.0041	S
	cartwheel	4.25	1.22	2.58	1.18	3.251	0.0021	S
	forward	4.44	1.54	3.15	1.88	3.258	0.0026	S
	backward	4.51	1.60	3.11	1.65	3.416	0.0017	S
	Dance element	4.54	1.44	3.10	1.58	3.321	0.0015	S

< 0.5 statically significant

Discussion

Table (4) shows the difference in Powerhouse physical fitness test for an experimental group and a control group, before and after the training program. All results revealed significant

differences for the experimental group, but no significant differences for the control group after program. The researcher claims that the improvement of Powerhouse indicates that the Pilates

program which occurs after 8 weeks of training includes the following:

- Improvement of strength endurance abdominal trunk cavity.
- Enhancing the posture stability.
- Improvement of flexibility and lengthening the spine.

Pilates approach focuses on Powerhouse and breath control, it facilitates activation of transversus abdominis, internal oblique, diaphragm, lumbar multifidus and pelvic floor muscles (Harrington et al 2005), and increases the oxygen supply in the body to build endurance (Karrie et al 2004).

The volume and intensity of Pilates exercise in this study was specific to cause physiological effects, augment the muscle size to promote strength endurance, and neuromuscular control of the local muscles.

The powerhouse muscle largely consists of type I or slow-twitch skeletal muscles (Sureporn et al 2011). Type I fibers contain plentiful mitochondria, high amount of oxidative enzymes and high

density of capillaries. These characteristics make them well adapted for endurance activities (Mc Ardle2007).

Thereby, the strength and endurance of type I fibers occur showing improvement of lumbo-pelvic stability (Richardson 2004). Improved recruitment and synchronous stimulation of these motor units also account for increased muscle strength (liemohn2001):

Pilates method is a combination of static and dynamic stretching exercises which are proper and safe to provide an increasing flexibility (Bandy1998).

The above fulfills the first hypothesis “There is a significant difference between pre/post test on physical fitness test for Powerhouse between the two groups (experimental, control group) in favor of post measurements”.

Table (4) shows the difference in level performance test for an experimental group and a control group, before and after the training program. All results revealed significant differences for the experimental group and the control group after program but the rate of change percent is

greater in experimental group than the control group.

The researcher claims that significant difference for two groups is due to perform any physical training which leads to improve performance level in this study. Consequently, the continuing and regular training improves physical fitness (strength, endurance, flexibility) and level performance.

Also that change rate of experimental group is higher than the control group. It is due the codified training program, which improve performance level. In general, a physical fitness level depends on the athlete's skills related to physical ability (Steinhofer 2003).

The perfection in motor skills was achieved only through the comprehensive development of physical, psychological and skill capabilities because the level of skill performance improves by the improvement of physical and psychological abilities (Michael King 2001) & (Shehata 2010).

This conclusion agrees with the findings of Salwa Mousa (2007), Smith et al. (2006) (23), which indicated

that the practice of regular sports activity through modern training helps to raise the level Fitness and motor improves the level of performance.

The above fulfills the first hypothesis "There is a significant difference between pre/post test on level performance for gymnastics between the two groups (experimental, control group) in favor of post measurements".

Table (6) shows the difference in Powerhouse physical fitness test and level performance for an experimental group and a control group, after the training program. All results revealed significant differences for the experimental group.

Pilates is marketed to athletes with the claims that it balances strength and flexibility, produces longer, leaner muscles, improves posture, increases core strength and, improves performance in sports (hodges2003). Pilates is a unique practice that focuses on foundational and functional movement skills, it can be practiced from 10 min to any variation thereof (Celeste et al2014).

Pilates is an exercise program as a core stability approach to augment the neuromuscular system to control and protect the core body or spine (latey2002). The core stabilizing muscles are great significance in traditional, established concept of the active organization of the human musculature (Verena G., et al2014).

Building and maintaining a strong center (Powerhouse) is essential to Pilates method and for good health in general for many reasons: supports and decompresses spine; promotes proper breathing; gives more energy and control over all of movements (AMY et al 2002), and improvement level performance in modern dance (alya2009).

The researcher concludes that Pilates training has contributed to the young female gymnastics a practice without fatigue, as the exercise accompanied by the maintenance of breathing and the development of the body during performance. A systematic and gradual Pilates training enable the muscles to obtain a large amount of oxygen-laden blood, to

increase the heart rate, to improve the joint rang of motion (ROM), and to prevent the contraction following the performance of the exercises. This would lead to improve physical fitness, and thus improve the level performance related to the elements of this study. This was not available to the control group, which relied on traditional program.

The above fulfills the third hypothesis “There is a significant difference between two groups (experimental, control group) on physical fitness test for Powerhouse and level performance for gymnastics in favor of post measurements”.

Conclusion

- The Pilates training led to a positive impact in Powerhouse which includes: improvement of strength endurance abdominal trunk cavity; enhancing the posture stability; improvement of flexibility and lengthening the spine).
- The Pilates training group improving the level performance for young gymnastics under10 years better than the other traditional training group.

Recommendations

1 - The use of Pilates exercises in gymnastics to improve the strength endurance of powerhouse, posture stability and flexibility.

2 - The use of Pilates exercises is vital for the development of level performance.

3- The use of Pilates exercises equipments to improve physical fitness and level performance.

4- Conducting studies to compare the effect of Pilates exercises with other exercises.

5- Conducting similar studies on other age levels and other sports.

Reference

1- Abdelminam S Borham (1995): Modern Gymnastics Encyclopedia, Dar Al Fikr Publishing& distribution, Amman, Jordan,45.

2- Adly H Bayomy (2001): Artistic groups in floor exercise, Dar Al Fikr Elarby , 3 ed, Cairo, Egypt, 130.

3- Alya A shams eldin(2009): Effect of Pilates training on psychology, motor fitness and Dance level performance, physical education collage for girls, Zagazig university.

4- Amy T Alpers, Rachell T segel (2002): the everything Pilates Book, Adams media pub, USA.

5- Bandy W, Irion J, Briggler M (1998): The effect of static and dynamic range of motion training on the flexibility of the hamstring muscles J Ortho Sports Phys Ther,**27**:295-300.

6- Celeste C, Brett H, Dawen M I, Tracey M (2014): Pilates for children and adolescents, pms (Pilates method Alliance) handspring pub United Kingdom.

7- Claessens, A.L., Lefevre, J., Beunen ,G.& Malina, R.M. (1999).The contribution of anthropometric characteristics to performance scores in elite female gymnasts. Journal of sports Medicine and Physical Fitnes, 39.355-360.

8- Denis w Austin(2002): Pilats for every body , strengthen lengthen and tone-with this complete 3-week body makeove , Rodale, U.S.A ,18.

9- Esam Abd Elkhalek (2003): Sports Training, 13ed , Dar Elmarf, Alx., Egypte.

10- Harrington L, Davies R. (2005) The influence of Pilates training on the ability to

contract the Transversus abdominis muscle in asymptomatic individuals J Body Work Mov Ther ,9:52-7.

11- Hodges PW(2003): Core stability exercise in chronic low back pain Ortho Clin North Am ,34:245-54.

12- Josef E Muscolion, Simona Cipriani (2004): Pilates and the powerhouse-1 , journal of bodywork and Movement Therapies, jan 2004, vol.8 (1), 15-24.

13- Karon Karter(2012) : the complete idiot's guide to the pilates on mat, Penguin Group pub, USA ,41 .

14- Karrie adamany , Daniel loigerot (2004): The Pilates Edge , library of congress , U S A, 5-6,11.

15- Latey P(2002): Updating the principles of the Pilates method, Journal of Body Work Movement Therapies , vol 6 (2) 94-101.

16- Liemohn W (2001) Exercise Prescription and the Back New York: McGraw-Hill.

17- Marie-jose blom (2012) : Pilates and fascia the art of working in, science direct Elsevier , 449-456.

18- McArdle WD, Katch FI, Katch VL (2007): Exercise Physiology: Energy, Nutrition, and Human Performance 6 ed. Philadelphia: Lippincott Williams & Wilkins; .

19- Michael King (2001) : Plaites work book illustrated step by step guide to mat work techniques , library of congress , U.S.A ,21 .

20- Richardson C, Hodges PW, Hides J (2004): Therapeutic Exercise for Spinal Segmental Stabilization in Low Back Pain: Scientific Basis and Clinical Approach Edinburgh: Churchill Living Stone.

21- Smith D , Dydeard T , Leger A(2006): Pilates Based therapeutic eercise effect on subjects with non specific chronic law back rein and dunctional disability a randomized controlled trial , jou thap sports phys there , Jul 36 ,

22- Steinhofer D.(2003): Das Athletik Trainings Theorie und Praxis zu Kondition, Koordination und Trainingssteuerung im Sportspiel, Philippike Sportverleg, Muenster , 210.

23- Sureeporn Phrompaet, MSc ; Aatit Paungmali, MPhty, PhD ; Ubon Pirunsan, MPhty, PhD ; and Patraporn Sitalertpisan, MSc, PhD (2011): Effects of Pilates Training on Lumbo-Pelvic Stability and Flexibility, Asian Journal of Sports Medicine. March; 2 (1): 16-22.

24- Tom Baranowski , Rusell Jago, Mariellel , Janker: effect of 4 weeks of pilates on the body composition of ypung girls , available online, 27 December , 2005 .

25- Tudor o. Bompa,phd (1999): Periodization training for sports, Human Kinetics, USA,48.

26- Verena. G, Alexander. B (2014): Pilates-A teachers 'Manual, Springer Medizin, Berlin Heidelberg, Germany 16,167-185.

27- Willson, J.D., Dougherty, C.P., Ireland, M.L. & Davis, I.M. (2005). Core stability and its relationship to lower extremity function and injury. Journal of the American Academy of Orthopaedic Surgeons, 13 (5), 316-325.