

Aqua Pilates versus Land Pilates: Physical Fitness Outcomes

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Abstract

Mat pilates programs on land have become a very safe and popular mode of exercise for all populations. Its adaptation in the water has been a more recent advance. Relevant literature, examining the benefits of both exercise programs are scarce. The purpose of the present study was to investigate the differences that may emerge from participating in the two types of Pilates (Land and Aqua), regarding physical fitness parameters body composition and dietary lipid composition. Forty women, with a mean age of 23.63 ± 2.71 , voluntarily participated in the study. Twenty of the participants had been following Land Pilates (Land) sessions for two years, twice a week, and the other twenty participants had followed Aqua Pilates (Aqua) sessions for two years, twice a week. The Eurofit fitness evaluation tests were applied to measure handgrip strength, muscle endurance, balance, and percent body fat. Aerobic capacity, was measured submaximally on a cycle ergometer using the Austrand-Rhyming test, and by extrapolation on the Austrand-Rhyming nomogram, their VO₂ max values were determined. Total cholesterol, was measured via the finger tip method by an instantly analyzed (Roche analyzer). The results revealed differences in body composition, flexibility and endurance of the abdominal muscles, while no differences occurred in total cholesterol, balance, handgrip strength and maximal oxygen uptake. In conclusion, both types of Pilates equally improved aerobic capacity, strength, muscle endurance and balance, with a similar benefit on blood cholesterol, while Land Pilates had a better impact on percent body fat and flexibility. It is possible that the lack of gravitational forces of Aqua Pilates, may depress energy expenditure and the forces necessary to improve flexibility. Future more controlled experimental research needs to further investigate the different outcomes between Aqua and Land Pilates.

Key Words: training programs, physical, physiological characteristics

Introduction

The beneficial effect of aquatic exercise in rehabilitation is known since the time of Hippocrates (460-375 b.Ch.). Ancient Greeks alternately used hot and cold water for the treatment of various diseases. Later, the Romans also widely used the water for refreshing and therapeutic purposes, having also devised four different types of baths with various temperatures (Duffield, M. H., 1973). Nowadays, hydrotherapy is considered as one of the safest methods for rehabilitation of patients for muscle relaxation, decrement of spasticity and significant reductions of sensitivity to pain and is applied without physical effort and therapeutic water temperatures between 33° and 35° C. However, aquatic exercise involves the active participation of the participants based on the principles and benefits of physical fitness for overall health improvement and is performed in cooler water temperatures of less than 28° C, to counterbalance the increased heat production induced by exercise (Holmer, I., 1979; McArdle, W.E. et al., 1976). Many aquatic programs nowadays are offered at variable temperature pool centers and provide both the aquatic exercise benefits and the healing benefits of warm waters. Individuals drawn to aquatic exercise are usually ones suffering from musculoskeletal problems and different types of arthritis or fibromyalgia pain since the effects of buoyancy and hydrostatic pressure minimize the load and impact on the muscle-skeletal system but also exercise provides all the cardiovascular and overall fitness benefits. Aquatic exercise programs attempt to apply all the different modalities that are applied on land for their specific benefits. Pilates on land, both on the mat and the reformer equipment has over the past decades gained great recognition and has become a very well accepted and preferable form of exercise for people of all ages, with all types of ailments as the exercise routines are well received by all, and physical fitness benefits are acquired without any type of injuries.

In recent years, aqua pilates programs are also becoming popular. However, limited research studies focus on the differences in benefits between these two forms. Land pilates exercise programs have been shown to significantly improve flexibility, balance and muscle strength of participants. There is also a general agreement that pilates stabilizes the spine by increasing torso strength, resulting in better postural alignment and movement. Thus, the human skeletal system functions in coordinated and more efficient ways. At the same time, Pilates exercise contributes in improving both physical fitness and body composition (Lange, C. et al., 2000; Bernardo, L., 2007).

Regular Pilates exercise enhances the quality of one's life, by providing physical and mental balance. Pilates exercises function correctively and contribute to the avoidance of potential injuries or weaknesses. Simultaneously it functions as a means of rehabilitation for minor injuries, because it is designed to strengthen the musculoskeletal system. In summary, the overall benefits of Pilates are documented to be, physical fitness improvements, proper body alignment, the enhancement of muscle strength, balance improvements, increases in flexibility, and rehabilitation of patients with back problems (Lange, C. et al., 2000).

Herrington and Davies (2005), conducted a comparative study in order to determine the muscle contraction strength of the transverse abdominal muscles, between healthy women exercising with the Mat Pilates method and women who followed a traditional abdominal strengthening program including. The results showed that women who exercised with the Pilates method were able to exploit the deeper abdominal muscles (to a percentage reaching 83% of the participants), exhibiting greater stability of the pelvic region in relation to those exercised by the traditional method of abdominal curls (42% of participants). Regarding pelvic stability, participants of the two control groups (exercise in the classic way and non-exercise controls) completely failed to pass the test. Segal and colleagues (2004), after a period of six months on Pilates participants' body composition was not greatly altered but they observed positive changes in posture, flexibility and reduction of morning stiffness of the participants. But Aladro-Gonzalvo et al., 2012, observed that a regular (daily) mat pilates regimen was able to increase energy expenditure and lead to weight loss and reduction of body fat.

Aqua Pilates has similarly proven to be an adequate form of exercise, and the limited literature provides evidence that it stimulates muscle strength, and improves posture, balance and flexibility. Aqua Pilates when transferred in the water uses the basic principles applied on land, focusing on whole body torso strengthening exercises, both on the vertical and supine position, with the aid of floatation equipment and the resistance of body weight. Aqua Pilates in elderly populations has demonstrated improvements in muscle strength, functional capacity, cardiovascular function, and aerobic capacity, in addition to stimulating fat burning by accelerating metabolism, and reducing low density lipoprotein values (LDL) (Takeshima, N. et al., 2002; Kopkáné-Plachy, J. et al., 2012).

Kopkáné-Plachy J. and colleagues (2012), with a random sample of 42 Hungarian retired women applied either a Pilates program (land) three times per week for six months, or an aqua-Pilates program twice per week in combination with a land pilates program once per week for six months, while a third group was the control group. The exercises that participants followed were focused on enhancing the strength, flexibility, range of motion and balance. The program included stretching exercises of chest, back strengthening of abdominal and lumbar spine, and balance exercises. The results revealed that both of land and aqua pilates programs had a beneficial effect on participants. Specifically, land pilates improved the abdominal muscles strength, the problems related to the spinal cord and posture, as well as enhanced the movement of the shoulder. On the other hand, aqua pilates program in addition to all the above benefits, improved the participants' flexibility, as well. In the same direction, Boguszewski, D. and colleagues (2012), used a random sample of 55 women aged 55-76 years. The first group followed a land pilates program (stretching and strengthening exercises, accompanied by quiet music), and the second group, an aqua pilates program (aerobic exercises, stretching and strengthening, accompanied by quick-dance music). Their results revealed that both programs improved the participants' flexibility, land Pilates program improved flexibility of lower limbs, aqua Pilates program improved muscle strength and endurance, and finally participants responded that their mood was improved and they wanted to keep on training.

So far, the available literature has only experimentally and for limited time exposed the participants to both forms of pilates and drawn conclusions. The purpose of the present study was to investigate the longitudinal benefits of women that had already been training for over a year with either Aqua or Land Pilates and assess the differences in their general physical fitness outcomes, and body composition and lipid profile, among healthy women, before the age of menopause.

Material & methods

Participants

Forty women, aged 23.63 ± 2.71 years, voluntary participated in this study after they informed about the investigation and signed an informed consent. The participants were divided into two groups. Twenty (20) women followed a regular Mat Pilates program with floor exercises, and twenty (20) women followed an Aqua Pilates program in the water. It was not considered as prerequisite for the participants to have certain ability or a specific athletic profile. The limitations that were set concerning participants were: (a) not to have entered in menopause, and (b) to have followed an hourly Pilates program, on either the land or in the water (depending on the group to which they belonged), at least twice a week and for longer than one year. The contents of both courses followed basic pilates guidelines, aiming for core stability and spine alignment, in combination with exercise principles aimed in overloading their aerobic system, and their strength and flexibility.

Measurements

Anthropometric measures were taken according to Lohman et al. (1988). In particular, body height (cm) was measured with precision of 0.1 m with a stadiometer (SECA, model 220, UK). Body mass (kg), with light, indoor clothing without shoes, was recorded with a scale (Bilance Salus, Italy) to the nearest 100 g. Body mass

index (BMI) was calculated according the from body mass and standing height ($\text{kg}\cdot\text{m}^{-2}$). Maximal handgrip strength of the dominant hand was measured with a specific hand dynamometer in kilograms (kg) and then was converted to Newtons by multiplying by 9.81 (Gerodimos, 2012). The dynamometer was set at 6.0 cm. Participants were standing and held the dynamometer without touching their trunk, in a downward direction. They performed two trials and the best was used. Skinfolts measurements were taken from five sites (biceps, triceps, subscapular, suprailiac and calf) to the nearest 0.1 mm. Flexibility of the participants was measured with “Sit and Test Reach” test which focuses on the flexibility of the low lumbar region and posterior thigh muscles (Wells & Dilon, 1952). The balance capacity was measured with “Standing Beam Test” (Eurofit) using a stabilized non-slip metal girder 50cm (height 5cm and 3cm wide). Participants had to stand on the beam without shoes, on one foot, while the free leg should be bent at the knee and paw resting on the buttock. The number of falls in 60 seconds balancing was measured and if more than 15 times in the first 30 seconds participant was fall, the test was terminated and the no score was obtained. Aerobic capacity ($\text{VO}_{2\text{max}}$) was calculated utilizing an ergometer cycle (Amila kh803), following the Astrand-Ryhming test ($\text{VO}_{2\text{max}}$ prediction was based on heart rate in submaximal effort). The abdominal muscles’ endurance was measured with maximal repeats in 30 sec time and finally, the cholesterol levels were recorded using a Roche instant analyzer. Blood samples were taken morning ours after 12 hours of fasting.

Procedure

The experimental procedure was accomplished in two phases involving: (a) the formal preliminary measurements and (b) the main experimental protocol. The first contact with participants was in the laboratory, in order to familiarize them with the process and measuring instruments. Before the main measurements, the anthropometric characteristics of the participants were taken. The main measurements of the subjects in both groups were held in calm conditions and performed under the same conditions and the same time of the day.

Statistical Analysis

The data analysis was performed with SPSS 21.0 and included: (a) means and standard deviation and (b) independent samples T-test for the control of the two groups’ differences in all the measured variables. Statistical significance for all the analyses was set at $p<.05$.

Results

The results of the present study revealed similar improvements in strength, aerobic endurance, balance and cholesterol levels in both groups exercising either in the Land Pilates or the Aqua Pilates group (Table 2). However, there were significant differences between the two groups in muscular endurance between the Land and Aqua Pilates, as tested by the maximum sit-ups repetitions in 30 seconds, their flexibility via the sit and reach test and their percent body fat (Table 2, Figure 1). Women exercising on Land Pilates exhibited better values in the above parameters, than women exercising in Aqua Pilates.

Physical and physiological characteristics of the sample

In the following table 1 the physical characteristics of the two groups are presented.

Table 1. Physical characteristics of the Land and Aqua Pilates groups.

	Age (y)	Body mass (kg)	Body height (cm)	Fat (%)
Land Pilates	25.95±4.96	60.35±8.13	168±0.06	26.91±3.28
Aqua Pilates	21.30±2.08	61.59±8.07	166±0.06	30.64±3.48

In the following Table 2, the physiological characteristics of the two groups are presented.

Table 2. Physiological characteristics of the Land and Aqua Pilates groups.

	TC (mg/l)	Balance (falls)	Abdominal endurance (repeats)	Flexibility (cm)	Handgrip strength (kg)	Aerobic Capacity $\text{VO}_{2\text{max}}$ L/min	Submax Peak Heart Rate b/min
Land Pilates	179.70±4.17	5.25±7.29	16.80±0.96*	30.00±1.14*	23.95±1.01	34.27±5.24	137±8.52
Aqua Pilates	178.65±3.72	4.93±7.43	14.20±0.66	19.90±1.95	22.15±0.54	31.10±7.31	143±8.15

* denotes significant differences at the $p<0.05$ level between Land and Aqua Pilates.

T-test results

The main purpose of the present study was to compare the efficiency of the two different training methods, throughout the evaluation and comparison of specific variables. The results of T-test for independent samples are presented in the following table 3.

Table 3. T-test results for Land and Aqua Pilates groups in specific variables.

	t	(df)	(p)
Body height	1.469	19	.158
Body mass	-0.505	19	.620
Fat %	-4.054	19	.001***
TC	0.194	19	.849
Balance	-1.636	19	.118
Abdominal endurance	2.848	19	.01**
Flexibility	4.188	19	.000***
Handgrip strength	1.614	19	.123
Bins/min in VO _{2max}	-1.242	19	.098
VO _{2max}	1.2	19	.091

Note: **=p<.01, ***=p<.001

A statistically significant difference is observed for body fat percentage, abdominal muscles endurance, and flexibility among the two groups. No statistically significant differences were observed for the variables of body height, body mass, total cholesterol, balance capacity, handgrip strength, cardiac bins at VO_{2max} and VO_{2max}. In the following figure 1 graphically the differences in body fat percentage, abdominal muscles endurance, and flexibility parameters among the two groups are presented.

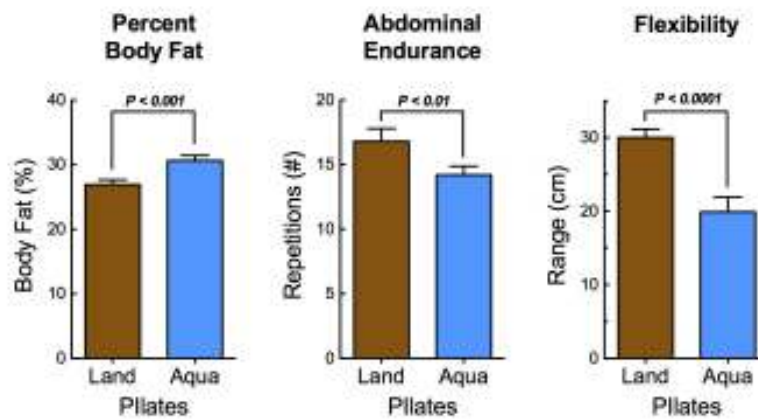


Figure 1. Differences in fat percentage, abdominal muscles endurance and flexibility variables among the two groups.

Discussion

The purpose of this study was to investigate possible differences between two different exercise methods (Land and aqua Pilates) in a specific women sample.

For the evaluation of these two programs, specific physical and physiological characteristics which demonstrably are effective according to the literature were selected. These characteristics were preferred so as to be representative of the physical and physiological parameters and could be measured in the field, avoiding the necessity of visiting the laboratory for main set of measurements.

Regarding body height and body mass of the two groups, no disputes were presented. However, differences appeared in terms of body fat percentage and in particular the land group revealed significantly lower values comparatively to water group. This result is in accordance with a previous study of Aladro-Gonzalvo and colleagues (2012), which have noticed a reduction of body mass, improvement of body composition and fat reduction rate, after a Land Pilates program. Similar findings, namely an improvement of body fat percentage after land Pilates program, were noticed by Takeshima and colleagues (2012). The problem is that none of these two studies can be compared e with each other or with our study, because they were based on different methodologies, such as longer or shorter period of the training program, different number of weekly workouts and without a control of the exercise intensity. However, the results of this study support the fact that both studies have beneficial physical fitness outcomes but suggest that Land Pilates may induce additional fitness improvements that cannot be elicited in the water, in terms of body image improvement as it is expressed by body fat percentage, and flexibility.

Regarding lipid ratio of total cholesterol (TC), although no significant differences between the two experimental groups, were presented, the fact that their values were well within the ideal range for health, demonstrate the benefit of both types of Pilates. No relative studies had so far presented the effect of Pilates on cholesterol values. A unique study investigating lipid indexes was that of Takeshima and colleagues (2002), who reported improvement of the sample's lipid profile after aqua Pilates training program. Regarding handgrip strength, no significant differences were also detected between the two samples. A unique study which reported muscle

strength improvement throughout land Pilates program, was that of Petrofsky and colleagues (2005), which reported improvement of strength in women trained in land Pilates. Our data confirm that comparable effect with both types of Pilates exercise (Land and Water).

Regarding the abdominal muscles endurance, a statistically significant difference ($p=.01$) among the experimental groups was noticed. Specifically, land Pilates group reached up to a mean of 16.8 sit-ups in 30 seconds, while aqua Pilates group reached up to only a mean of 14.2 repetitions. The obvious difference between the two programs is explained by the fact that land Pilates programs are based and designed to strengthen the abdomen and spine muscle groups (rectus abdominis, iliopsoas, oblique abdominals) and the back and work against gravity on land, in order to achieve appropriate posture and spine problems improvement (Lange, C. et al., 2000; Herrington and Davis, 2005). It is obvious that aqua Pilates causes adjustments in strengthening the musculature of the waist, without however to be as effective as land Pilates. This could be a result of the effect of buoyancy which greatly reduces body weight and thus the load of the body in the water.

The most significant difference between the two experimental groups was reported the characteristic of flexibility ($p < .001$), whereas aqua Pilates group reported an average of 19.90 cm, while the land group, 30 cm respectively. This is the first study to demonstrate a greater improvement on land than in the water. Many researchers in literature have studied “flexibility” in training Pilates programs (land and water) with beneficial outcomes (Segal et al., 2004; Kopkáné-Plachy et al., 2012). It is obvious that in the present study, the land group revealed significantly elevated flexibility compared to water, which was possibly due to the the greater load of the body when stretching when all the gravitational forces are in effect, or perhaps on better stretching routines at the beginning or the end of the Pilates program on Land.

Finally, with respect to their VO₂ max and submaximal peak heart rates, it was confirmed that no statistically significant differences were observed between the two experimental groups. A gap in literature regarding comparison of the two programs in these parameters is obvious, except Takeshima and colleagues (2002) investigation, which reported improvement in maximal oxygen uptake of their sample, after Pilates exercise intervention in the water. However, observing the differences between the two experimental groups a slight superiority of land group in VO_{2max} capacity (34.27 ml/kg/min vs 31.10 ml/kg/min) was detected, but marginally not statistically significant. This predominance of the land program could possibly be explained by the continuity of the program’s exercises, without great pauses, and by the intensity of the effort applied.

Conclusions

In conclusion, given the homogeneity of the two experimental groups in respect to the age, body height, body weight, training experience, frequency and duration of training, both Pilates -Aqua & Land- had a positive effect on physical fitness but a slight predominance of Land Pilates over Aqua Pilates is evident. However, we should not rush to promote the superiority of one over the other, as aquatic programs are often prescribed to people that cannot exercise on Land due to pain or physical limitations and in this case Aqua Pilates may prove as an exercise fitness stimulus for an otherwise sedentary lifestyle. Overall women in both pilates programs exhibited a good physical fitness based on norms for their age. However, women exercising on land acquired better flexibility, abdominal endurance and body composition. Further research needs to elucidate whether these differences stemmed from a different initial level of fitness or a difference level of intensity of the programs that were followed the year preceding the measurements. Based on the above data it appears that various exercise modalities that are applied on land may possibly not carry over the same benefits when transferred into the water. This needs to be taken into consideration when prescribing exercise that aims in improving and benefiting all fitness parameters. Due to the lack of gravity it is possible that certain fitness parameters can be enhanced and supplemented with exercising on land as well.

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