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The Effects of Pilates Exercises on Some Elements of Physical Fitness and Body Composition

Abstract. The primary goal of this paper is to assess the effects of Pilates exercises on some elements of physical fitness, such as flexibility, trunk muscle strength, general balance, and body composition during a 6-month observation period. The experimental method was used in the study. The variables were verified using selected elements of an internationally used test called “Eurofit” for adults, namely, trunk muscle strength, flexibility, and general balance. The study was comprised of 17 women with an average age of 50.65 ± 13.74 , who met the inclusion criteria. Average study results show that class participants made the greatest progress with regard to flexibility and trunk muscle strength. The study results show that Pilates classes are an effective training method, especially as far as improving flexibility and trunk muscle strength is concerned.

Keywords: Pilates, physical activity, flexibility, trunk muscle strength, general balance

1. Introduction

The contemporary lifestyle is associated with a number of stressors that are increasingly responsible for a sense of discomfort, especially due to reduced quality of life [Sas-Nowosielski 2003]. At the same time, numerous types of targeted physical activity have been shown to stimulate both mental and physical well-being. Recognition of the value of the impact of Pilates exercises is economically optimal and easy to implement in Poland. The promotion of Pilates classes may help encourage society to improve their health through health-oriented measures. Therefore, estimating the value of these classes may have a tangible effect on people of both sexes and all ages with regard to physical fitness.

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Joseph Pilates established a system of exercises based on his belief that a good state of the body is achieved through the combination of physical fitness and positive thinking. The Pilates method is highly effective when principles such as breath, control, concentration, centring, precision and flow of movements are observed. Conscious and appropriate breathing is essential to these exercises as it helps to achieve concentration, more effective learning, and relaxation within the pelvis [Gavin 2006]. Each exercise has its breathing rhythm and begins by inhaling or exhaling; breathing must therefore be regular and fluent. Additionally, all movements start with a stable and contracted centre. This is the main, invisible centre of strength called the powerhouse made up of the transverse abdominal muscle and the multifidus muscle [IFFA training material 2014]. The common problem of low back pain and bad posture may be suggestive of a weak core, which is why strengthening the abdominal muscles is one of the fundamentals of Pilates exercises. Moreover, precision and constant focus on the performed exercises are also essential. This way, the movements are both conscious and fluent. Motivation and a positive attitude are also of key importance. Establishing the image of the desired effect and keeping it as a source of inspiration and motivation may become an important stimulus for further exercises [Gavin 2006].

In the case of contemporary people who are at risk of non-infectious diseases, such as chronic fatigue, stress and depression, the type of physical activity that one engages in is particularly important. Pilates exercises are performed with great precision, with the body and mind well balanced and connected [Gavin 2006]. Exercises that are aimed at strengthening muscles, especially those of the abdomen [Korzeniewska 2004: 13-15] as well as muscles that support the spine, shoulder girdle and pelvis [Gavin 2006: 21] help reduce back pain while additionally improving participants' psychological health [Ellsworth 2011]. Pilates classes significantly reduce tension and everyday stress and are therefore an excellent way to relax [Ellsworth 2011]. These classes help improve participants' mood and increase their ability to concentrate [Mazur & Marczewski 2011]. Moreover, Pilates exercises play an important role in improving functional performance [Lange, Unnithan, Larkam & Latta 2000: 99-108]. During a 4-week training scheme, Russ Jago et al. [2006] found that blood pressure was regulated and BMI reduced, suggesting that Pilates exercises may help prevent overweight and obesity.

The philosophy of Pilates classes focuses on the improvement of some elements of physical activity, such as trunk muscle strength and flexibility. It's directly linked with health-related fitness (H-RF concept) [Grabowski & Szopa 1991]. Lower back pain relief is an important element of these classes. Studies by Hildebrandt [1987] and Frymoyer and Cats-Baril [1987] quoted by Winand Osiński [2003] point to the measurement of trunk muscle strength as an important index of low back pain. Additional studies [Osiński 2003, quoted after Jørgensen and Nicolaisen 1986; McNeil et al. 1980; Smidt et al. 1987; Thorstensson and Arvid-

son 1982] have confirmed the importance of trunk flexor and extensor muscle endurance and strength in back pain occurrence. Moreover Osiński [2003] believes that limited spinal mobility co-occurs with the risk of low back pain. Pilates classes also play a role in positive aging which explains the importance of general balance measurements. This issue is especially important for women in their senior years due to the elevated risk of osteoporosis. Poor motor fitness is often a significant risk factor associated with increased numbers of falls and serious complications of femur fractures [Osiński 2003, quoted after Sattin 1992; Oja & Tuxworth 1995].

With all of the above in mind, it seemed interesting to assess the impact of Pilates classes on some elements of physical fitness – trunk muscle strength, flexibility and general balance – during a 6-month observation period. It was also of interest to ascertain which of the selected components of physical fitness changed the most during a systematic training scheme. The study was supplemented by an analysis of body composition.

2. Study group and methods

In early December 2011, female residents of Nowy Dwór Mazowiecki were enrolled for Pilates classes in collaboration with the Cultural Centre of Nowy Dwór Mazowiecki (Nowodworski Ośrodek Kultury). Information on the classes was conveyed via posters and webpage. The following inclusion criteria were applied:

- specific gender (women),
- specific age (35-60 years old),
- specific place of residence (the town of Nowy Dwór Mazowiecki),
- no previous experience with organised fitness classes,
- no previous experience with Pilates classes.

The study comprised healthy, middle-aged women with no chronic diseases. According to [Harwas-Napierała & Trempała 2004], middle adulthood refers to the ages of 35-40 through 55-60. This is in line with the classification by Erik Erikson [2004] who identifies the following:

- Early adulthood between the ages of 21 and 34,
- Middle age adulthood between the ages of 35 and 60/65,
- Senior adulthood after the age of 60/65.

The experimental method was used in this study. The protocol for the study was approved by the Bioethics Committee. Twenty women aged 50.65 ± 13.74 applied to participate in the classes and 17 of these (who met the inclusion criteria and completed the 6-month Pilates training programme) were included in the study. The 60-minute classes were held regularly, twice a week, between January

and June 2012, and led by a certified Pilates instructor. The focus was on exercises on mats only. The training programme was based on the first 7 Pilates exercises along with preparatory exercises:

- The Hundred,
- The Roll Up,
- One Leg Circle,
- Single Leg Stretch,
- Shoulder Bridge,
- Side Leg Series,
- Swimming.

In the initial phase of the programme, the focus was on gradually preparing participants' bodies for the original versions of exercises. Exercises were introduced step by step, beginning with the Single Leg Stretch, Swimming and Shoulder Bridge, followed by the Side Leg Series and the Roll Up. The last exercises to be introduced were the Hundred and One Leg Circle.

In the first week of January, selected elements of physical fitness were measured using the Eurofit for adults test, namely flexibility (sit and reach test), trunk muscle strength (dynamic sit-up test) and general balance (single leg balance test).

Additionally, bioimpedance analysis of body composition was performed using a Tanita scale (Medical Approved Analyser) with CE0122 certification and compliant with the Medical Device Directive 93/42/EEC. The tests were performed once again in the last week of June, after the programme was completed. The following parameters of body composition were included in the study:

- BMI (body mass index),
- body weight,
- fat tissue content,
- PMM (predicted muscle mass),
- FFM (fat-free mass),
- bone tissue mass,
- TBW (total body water).

The Wilcoxon signed-rank test for two related samples was used for statistical analysis with the significance level at $p < 0.05$. This test was used as a non-parametric equivalent of the paired sample t-test which may be used for small samples. Calculations were made using Statistica 10.

3. Results

The variables were verified using selected elements of an internationally used test called Eurofit for adults, namely trunk muscle strength, flexibility and general

balance. Average study results showed that participants made the greatest progress in flexibility and trunk muscle strength. Detailed data is shown in Table 1. No statistical differences were found in general balance measurements.

Table 1. Analysis of some components of physical fitness

Selected elements of test Eurofit for adults	January 2012 (average±SD)	June 2012 (average±SD)	p-value
Flexibility	6.6±8.5	10.4±7.9	0.000438***
Trunk muscle strength	10.9±5.0	12.1±4.9	0.017961**
General balance	1.2±1.5	0.9±1.6	0.386271

Legend: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Source: The Wilcoxon signed-rank test.

No statistical differences in the group were found in body composition. However, an analysis of particular parameters showed minimal but positive changes with regard to fat-free mass and muscle mass. Detailed results are shown in Table 2.

Table 2. Bioimpedance analysis of body composition during the 6-month observation period

Period of time		BMI (kg/ m ²)	Body weight (kg)	Fat tissue		Muscle tissue (kg)	Fat free mass (kg)	Bone tissue (kg)	Total body water (TBW) (%)
				%	kg				
January 2012	Standard deviation (SD)	24,8	66,2	31,3	21,5	42,5	44,7	2,3	45,0
	Average	4,6	13,0	7,2	9,0	4,2	4,5	0,2	12,3
June 2012	Standard deviation (SD)	24,7	66,3	30,2	20,8	43,2	45,5	2,3	48,4
	Average	4,6	13,0	7,4	8,9	4,8	5,1	0,2	4,7
The Wilcoxon sig- ned-rank test (<i>p</i>)		0,70	0,43	0,42	0,71	0,22	0,20	0,13	0,20

Source: The Wilcoxon signed-rank test.

4. Discussion

A review of literature reveals that very few papers analyse the effects of Pilates exercises in healthy adults using the experimental method. This was confirmed e.g. by Lisa Marie Bernardo [2007: 106–110] who found that only 10 out of

277 such papers were published in professional journals. Moreover, five of these dealt with dancers and gymnasts, two with special groups, and only three referred to the population in question, i.e. healthy adults. The author saw the need to take on the issue of the effectiveness of Pilates exercises, mainly due to the small number of experimental projects, small study populations and some irregularities in defining Pilates exercises [Bernardo 2007: 106-110]. Most studies that deal with the effectiveness of Pilates exercises seek to assess variables such as strength, muscular endurance, flexibility, and balance. A smaller number of publications focus on body composition measurements.

According to Claudia Lange et al. [2000: 99-108], the positive effects of Pilates exercises may be divided into three categories. These include enhanced physiological functioning, enhanced psychological functioning and learning or re-learning of functionally effective postural sets and motor patterns.

The primary goal of these studies was to verify the effect of a particular factor, i.e. targeted physical exercises in the form of Pilates on physical fitness and body composition, as well as the positive effect of the improvement of these on quality of life. Our own studies suggest significant changes in two of the studied parameters: flexibility and trunk muscle strength. A marked improvement was observed during systematic, six-month Pilates training. These findings were confirmed by studies by Lee Herrington and Rachel Davies [2005: 52-57]. Women who took part in regular Pilates classes held once a week for 6 months. Study results showed better stabilisation of the transverse abdominal muscle in class participants compared with the control group who did not exercise. Moreover, women in the experimental group were shown to be able to use deep muscles and pelvic muscles more effectively. Neil A. Segal et al. [2004: 1977-1981] observed the greatest improvement in flexibility in a study assessing 16 individuals who took part in weekly 60-minute classes held over a period of 6 months. Participants also pointed to improved posture and flexibility. Betül Sekendiz et al. [2007: 318-326] performed a 5-week observation study. Study results showed significant differences in muscular strength and endurance, as well as flexibility measurements compared with the control group. The Pilates method is effectiveness due to enhanced abdominal muscle strength and improved posture in class participants [Emery et al. 2009: 124-130].

Bernardo [2007: 106-110] suggests that Pilates exercises may be of critical importance for individuals seeking a successful training method that is not associated with a health risk for joints and muscles while at the same time employing multiple muscle groups.

Our own studies covered a short observation period of 6 months. No significant changes in body composition were found with regard to any of the discussed parameters during this time. However, a detailed analysis reveals positive albeit statistically insignificant changes in fat-free and fat mass. Studies by other

authors (Seagal et al., Sekendiz et al.) also showed no effect of Pilates exercises on changes in body composition.

The elements of physical fitness most commonly studied by authors include flexibility, strength and balance [Bernardo 2007]. The importance of balance is most pronounced in older women with a greater risk of femur fractures due to osteoporosis. Although our own studies revealed no significant statistical differences in general balance measurements, the effectiveness of Pilates classes with regard to this parameter was confirmed by studies by other authors. Erik G. Johnson et al. [2007: 238-242] observed a significant improvement in the experimental group. The authors also highlighted that Pilates classes could offer an effective way to improve dynamic balance in active adults as well as sportsmen and sports-women seeking new, cheap tools to improve particular motor features [Johnson et al. 2007: 238-242].

With regard to the main assumption of Pilates classes, i.e. improved physical fitness in terms of trunk muscle strength and flexibility, these classes may be said to significantly influence respondents' quality of life. This is manifested first and foremost by reduced lower back pain due to improved flexibility and the strengthening of the powerhouse, i.e. core muscles. This in turn translates into improved performance of daily activities and improved quality of life in respondents. These findings were confirmed by Vijay B. Vad et al. [2007: 577-582]. Here, the authors stated that 70% participants of Pilates class reported significant pain reduction and improved satisfaction with life after completing a training scheme compared with the control group. On the other hand, reported improved overall health, improved possibilities for participating in sports activities, enhanced flexibility and reduced pain in the group that took part in Pilates classes compared with the control group [Gladwell et al. 2006: 338-350]. Another authors [Rydeard et al. 2006: 472-484] showed that the Pilates group achieved significantly reduced functional impairment and reduced pain intensity compared with the control group. The health benefits of Pilates exercises were also acknowledged by Susan Sorosky et al. [2008: 39-47]. The authors state that since these exercises aim to improve trunk strength and flexibility and to develop the ability to relax, they may be very helpful and highly recommendable especially in patients with chronic low back pain.

It can also be noted that Pilates classes help strengthen trunk muscles, including pelvic floor muscles Culligan et al. [2010: 401-408]. The authors compared the effects of specialist pelvic floor muscle training (PFMT) and Pilates classes that were also aimed at strengthening pelvic floor muscles. Both exercise programmes turned out to be effective (significantly improved) and may be beneficial e.g. for individuals with urinary incontinence.

The authors of the abovementioned studies suggested that Pilates exercises offered better therapeutic effects than standard healthcare such as pharmacologi-

cal treatment. However, the authors added that very few papers were available concerning experimental studies of Pilates exercises and as a result, proof of their effectiveness seemed unclear. Our own studies also confirm that a thorough analysis of Pilates classes using the experimental method with a larger study group is necessary. Unfortunately, in our study the small sample size of 17 participants and lack of control group do not allow for a reliable assessment of these classes. Therefore, further research should refer to the holistic effects of Pilates classes on the psychology and physiology of participants. In summary, there is a need for more detailed measurements, analyses and clinical studies.

5. Conclusions

Study results show that Pilates classes are an effective training method, particularly with regard to improved flexibility and trunk muscle strength. Due to the health-oriented nature of Pilates exercises, their promotion may turn out to be an effective tool in pain management, especially low back pain.

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Wpływ zajęć pilates na wybrane elementy sprawności fizycznej i skład ciała

Streszczenie. Głównym celem pracy było zdiagnozowanie wpływu zajęć pilates na wybrane elementy sprawności fizycznej, takich jak: gibkość, siła mięśni tułowia, równowaga ogólna oraz skład ciała w trakcie pół rocznej obserwacji. W badaniach posłużono się metodą eksperymentalną. W celu zweryfikowania zmiennych zastosowano wybrane próby z międzynarodowego testu Eurofit for adults: siły mięśni tułowia, gibkości i równowagi ogólnej. Do badań wzięto pod uwagę

17 kobiet w wieku $50,65 \pm 13,74$ lat, które spełniały określone kryteria włączenia. Średnie wyniki badań wskazują, że ćwiczące uzyskały największy postęp w gibkości oraz sile mięśni tułowia. Badania wskazują, że zajęcia pilates są skuteczną metodą treningową, szczególnie w odniesieniu do poprawy gibkości ciała i wzmocnienia siły mięśni tułowia.

Słowa kluczowe: pilates, aktywność fizyczna, gibkość, siła mięśni tułowia, ogólna równowaga