



Physical and psychological benefits of once-a-week Pilates exercises in young sedentary women: A 10-week longitudinal study



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HIGHLIGHTS

- A single isolated 60-min Pilates exercise improved mood in sedentary women.
- Once-a-week Pilates training improved body awareness after only ten weeks.
- Muscle mass, balance, flexibility, core- and abdominal muscle strength were increased.

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ABSTRACT

Pilates exercises have several demonstrated physical and psychological benefits. To date, most research in this context was conducted with symptomatic or elderly people with few dependent measures. The current study examined the chronic or longitudinal effects of very low frequency, once a week, Pilates training on several physical and psychological measures, over a 10-week intervention, in young, healthy, and sedentary women. Further, the study gauged the acute effects of Pilates exercises on positive- and negative affect in 10 exercise sessions. Compared to a control group, the Pilates group exhibited significant improvements in skeletal muscle mass, flexibility, balance, core- and abdominal muscle strength, body awareness, and negative affect. This group also showed favorable changes in positive (22.5% increase) and negative affect (12.2% decrease) in nine out of ten exercise sessions. This work clearly demonstrates the acute and chronic benefits of Pilates training on both physical and psychological measures. It also reveals that even only once a week Pilates training is enough to trigger detectable benefits in young sedentary women. While this frequency is below the required levels of exercise for health, it may overcome the 'lack of time' excuse for not exercising and subsequently its tangible benefits may positively influence one's engagement in more physical activity.

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1. Introduction

1.1. The Pilates exercise

The Pilates exercise system is a composite of movement styles and philosophy of gymnastics, martial arts, yoga, and dance [40]. It aims to develop and maintain a perfect balance of mind and body, based on six fundamental principles: concentration, control of all aspects of movements, being aware of the center of the body, flowing movements, precision, and breathing [40,62]. From a physical point of view, Pilates exercises are intended to enhance muscle strength and endurance, increase flexibility, and improve balance [36]. According to recent empirical reviews and meta-analyses, the Pilates method is able to reduce

pain and improve the functional abilities of patients with chronic low back pain [46,48,63], and has beneficial effects in other problems (e.g., fibromyalgia syndrome, breast cancer, osteoporosis, postpartum fatigue) [3,6,24,39,44].

1.2. Physical benefits

Various positive physical and psychological effects of regular Pilates training were reported in healthy individuals, as well. Improvements in lumbo-pelvic control and core posture [19,23,31,49,52], flexibility [4,49,58], and static and dynamic balance [9,18,20,21,34] were found in several studies, although non-significant findings have also emerged [17,58]. Promising results in decreasing body fat mass and increasing lean body mass were also reported [14,26], however, the overall quality of these studies does not warrant the drawing of firm conclusions [1,55]. Improvements in physical activity, strength and balance are particularly beneficial for older adults as they prevent falls and generally increase

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physical fitness [8,9,13,21,33], but also for sedentary individuals, given that sedentary lifestyle appears to be clearly linked to an increased risk of diabetes, cardiovascular disease and all-cause mortality [65].

1.3. Psychological benefits

Concerning psychological functioning, significant improvements in sleep- and life-quality was found among university students, middle-aged people, and the elderly population after Pilates training [13,16–18,21,27,41]. In two studies, Pilates exercises significantly increased mindfulness (i.e., a non-judgmental and present-oriented information processing style), which then partially mediated the connection between Pilates and various psychological indices (e.g., self-efficacy, mood, perceived stress, sleep quality; [15,16]). The weekly frequency of these longitudinal Pilates inquiries was two to three workout sessions per week with an overall length of 8–15 weeks.

1.4. Pilates training once a week

Low frequency intervention studies, using only one Pilates training session per week, were conducted with elderly or symptomatic samples. Their results demonstrate that the benefits of Pilates on some health, physical, or psychological aspects could be seen even after single weekly workouts. For example, Pilates training once a week, lasting for six weeks, has improved general health, pain level, physical functioning, flexibility, and proprioception in individuals with chronic low back pain [28]. In a similar investigation, one Pilates training a week, also lasting for 6-weeks, reduced neck pain in sufferers [42]. Physical and balance (a reduced risk of falling) benefits were also seen after 8-weeks of single weekly Pilates training in older adults [47]. Similar findings were reported by Boguszewski et al. [10] who observed an increased suppleness in the lower body part of elderly women, that was also accompanied by a decrease in trait anxiety, after once a week Pilates training lasting for 10 weeks. Finally, recent evidence has demonstrated that women diagnosed with postpartum depression who took part in a 10-week of combined yoga and Pilates training, only once a week, experienced reduced depressive symptoms and fatigue after the 10 exercise sessions [37]. Therefore, there is strong evidence for the benefits of low-frequency (once a week) and short-duration (6–10 weeks) Pilates training programs on both physical and psychological health. However, most of the work, demonstrating the short-duration and low-frequency-based positive results of Pilates exercises, was conducted with elderly or symptomatic samples. Therefore, their findings cannot be confidently generalized to the non-symptomatic sedentary young-adult population.

1.5. Rationale and hypotheses of the study

Given that the physical benefits of Pilates training appear with single weekly sessions, it is important to address both the physical and psychological benefits of this exercise simultaneously, from a multivariate perspective, and to establish the effects of Pilates workouts in young and healthy populations, in which research is lacking. Pilates training only once a week, particularly for individuals having a sedentary lifestyle, may foster the transition to a healthy and active lifestyle, especially if rewards, in the form of tangible physical and psychological benefits, are experienced by the practitioners.

Studying a young sedentary sample, in the current 10-week longitudinal field study, we tested the hypotheses that once a week Pilates training will (1) increase muscle mass and decrease body fat; (2) improve balance, flexibility, and strength; and (3) lead to positive changes in participants' psychological well-being, body-awareness, and mindfulness. Additionally, at an exploratory level, we also tested the relationships between the changes in physiological and psychological variables. We hypothesized, that (1) changes in body dissatisfaction will be linked to changes in skeletal muscle mass (inversely) and body fat decrease (if

any); and (2) changes in body awareness will be related to changes in both dynamic and static balance.

2. Methods

2.1. Participants

The required sample size was determined before the inquiry in two steps using the G*Power software (v.3.1.9.2; [25]). First, considering an effect size of 0.5, α of 0.05, and $1-\beta$ of 0.8, a total sample size of 34 (17 in Pilates and 17 controls) was calculated for the interaction term of a 2×2 mixed analysis of variance. Second, since correlation analyses within the Pilates-training group was also planned, the size of the intervention group was determined to be 32, which is the critical value for a medium level effect size of 0.35 (with $\alpha = 0.05$). The final sample consisted of 18 women in the control group (mean age = 20.94 ± 1.60 years), and 32 women in the Pilates group (22.2 ± 2.30 yrs).

Participants were recruited via advertisements in the student facilities of a large urban university. The inclusion criteria were: female gender, being a university student, sedentary lifestyle (no regular physical activity in the last three months, and no planned regular physical activity for the next four months), and absence of health complications, especially chronic cardiovascular, pulmonary, and/or orthopedic dysfunctions. Those who volunteered were randomized into Pilates training and a control group who had the chance to enroll after the study in Pilates training, thus representing a usual 'waiting list control group'.

The study was approved by the Ethics Committee of the Institutional Review Board at a large university and all the participants read and signed an informed consent form before taking part in the study. The research was conducted in full accord with the ethical principles for research with human subjects of the Helsinki Declaration [66].

2.2. Materials

2.2.1. Questionnaires

Participants' awareness of the internal changes and events of their body was assessed using the 18-item Body Awareness Questionnaire (BAQ; [38,56]). Items are answered on a 7-point Likert scale with the anchor points of 1 ("not at all true about me") to 7 ("very true about me"). Higher scores refer to higher levels of body awareness. Internal consistency of the scale was 0.88 at both (i.e., baseline and follow-up, see below) measurements.

Attitudes toward the body were assessed using the 20-item Body Attitude Test (BAT; [51]). Items are answered on a 6-point Likert scale ranging from 1 ("never") to 6 ("always"). Higher scores reflect higher levels of dissatisfaction with the body. In the current study, Cronbach's alphas were 0.86 at the baseline and 0.90 at the follow-up assessment.

Nonjudgmental, pre-reflexive information processing style (mindfulness) was measured using the Mindful Awareness Attention Scale (MAAS; [11,57]). The scale consists of 15 items that are answered on a 6-point Likert scale that ranges from 1 ("almost always") to 6 ("almost never"). Higher scores indicate higher levels of mindfulness. In the current investigation, the internal consistency of the scale, at the two measurements, was 0.84 and 0.83, respectively.

Acute and long-term changes in affect were assessed using the Positive and Negative Affect Schedule (PANAS; [29,61]). The PANAS measures positive and negative emotional states as independent dimensions (10 items for positive and 10 items for negative affect) on a 5-point Likert scale with the anchor points of 1 ("very slightly or not at all") to 5 ("very much"). Higher scores indicate elevated levels of positive- and negative affect. Depending on the instruction, the scale measures the actual state of positive and negative affect as well as their perceived state over a longer period of time. In the current study, both options were used; the PANAS was administered for participants in the Pilates group before and after each session to measure acute

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