

The Effect of Pilates Training on Body Composition

Pilates Eğitiminin Vücut Kompozisyonuna Etkisi

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Abstract: In today's context, Pilates stands out as a prevalent exercise approach among women. Developed by Joseph Hubertus Pilates (1880-1967), this method draws inspiration from both Eastern and Western philosophies, blending yoga's mental focus and specialized breathing techniques with the physical elements of gymnastics and other sports. Pilates offers various benefits as an exercise method. It can enhance flexibility, strength, and endurance while benefiting from one of its principles, emphasizing the importance of full and deep breathing. Maintaining a healthy body includes losing body fat, maintaining an ideal balance, and having elastic muscle strength and a flexible spine, all of which the Pilates method effectively addresses as a means to achieve these goals. Hence, the significance of consistently engaging in Pilates exercises becomes apparent. This study aims to provide general information about Pilates and examine the impact Pilates exercises have on body composition when performed regularly, based on studies that elucidate this aspect.

Keywords: Pilates, Body Composition, Sports, Exercise

Özet: Günümüzde, Pilates, kadınlar arasında oldukça popüler bir egzersiz yaklaşımı olarak öne çıkmaktadır. Joseph Hubertus Pilates (1880-1967) tarafından geliştirilen bu metod, Doğu ve Batı felsefelerinden esinlenerek yoga'nın zihinsel odaklanma ve özel nefes alma teknikleri ile jimnastik ve diğer sporların fiziksel öğelerini birleştirmiştir. Pilates, bir egzersiz yöntemi olarak çeşitli faydalar sunmaktadır. Esneklik, güç ve dayanıklılığı artırabilir ve tam ve derin nefes almanın önemini vurgulayan prensiplerinden birinden yararlanılabilir. Sağlıklı bir vücuda sahip olmanın prensipleri arasında, vücut yağını kaybetmek, ideal dengeyi korumak, elastik kas kuvvetine ve esnek bir omurgaya sahip olmak yer alır ve Pilates yöntemi bu hedefe ulaşmada etkili bir yol sunar. Bu nedenle, sürekli olarak yapılan Pilates egzersizlerinin önemi ortaya çıkmaktadır. Bu kapsamda yapılan bu çalışmanın amacı Pilates hakkında genel bilgi vermek ve pilates egzersizlerinin düzenli olarak yapıldığı durumlarda vücut kompozisyonu üzerindeki ne düzeyde etki oluşturmada olduğunu belirten çalışmalar çerçevesinde incelemektir.

Anahtar Kelimeler: Pilates, Vücut Kompozisyonu, Spor, Egzersiz.



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Introduction

The development of computers and technology began with the creation of personal computers, followed by the advancement of the Internet and mobile devices (Çakır et al., 2022). Today, there is an increase in technological developments that allow individuals to perform many activities more efficiently and with less energy expenditure, aiming to enhance their quality of life. However, it is observed that the free time provided by these new technologies is often not utilized to improve individuals' quality of life. The lack of physical activity during the day, brought about by a sedentary lifestyle, negatively affects individuals' bodies. Numerous impacts of a sedentary lifestyle on individuals can be mentioned. Mainly, individuals who live a sedentary (inactive) lifestyle are at risk of developing hypokinetic diseases such as hypertension, high cholesterol, coronary heart diseases, obesity, cancer, and musculoskeletal disorders. Individuals who spend long hours working intensively at desks in enclosed spaces face various health issues caused by a sedentary lifestyle (Bravata & Smith-Spangler, 2000; Coşkunürk et al., 2022). Therefore, regular physical activity reduces the risk of these diseases, prevents premature deaths, and supports maintaining quality of life. It can be said that people participate in daily physical activities for various purposes, such as skill mastery, joy, acceptance, achievement, self-esteem, and enjoyment (Lakmalı et al., 2021). Physical activity and exercise improve body composition, reduce the risk of diabetes and coronary

artery disease, alleviate joint pain and depression, enhance individuals' quality of life, contribute to the extension of life expectancy, and prevent obesity (Bek, 2008; Biçer et al., 2005; Şavkın, 2014).

Pilates has become a very popular exercise approach among women today. Developed by Joseph Hubertus Pilates (1880-1967), Pilates combines the mental focus and specific breathing techniques of yoga with the physicality of gymnastics and other sports, inspired by Eastern and Western philosophies (Muscolino & Cipriani, 2004; Kloubec & Banks, 2013; Şavkın, 2014). Pilates exercises aim to create a solid skeletal structure in the upper body by equally strengthening the abdominal and back regions. In Pilates, the body's centre consists of deep muscles closest to the spine.

In traditional exercises, weak muscles tend to become weaker, and strong muscles tend to become stronger. This leads to an imbalanced muscle structure in the body, causing chronic back pain and injuries. In Pilates, the muscle structure is integrated as a whole (Segal et al., 2004; Ersoy, 2008).

Pilates exercises are classified into three main forms. First, there is Classical/Traditional Pilates, which includes J. Pilates' original 40 high-load exercises performed on a mat with tools such as mini balls and Swiss balls. Second, there is modified/adapted Pilates, which uses reformer machines and other Pilates equipment, combining both high and low-load exercises; this form is fitness-based and may include various

apparatus. Third, there is clinical Pilates, used by physiotherapists for therapeutic purposes (Isacowitz, 2006; Purdy, 2009; Şimsek & Katırcı, 2011). Pilates exercises are particularly implemented to improve body posture and achieve a healthy body through movements that require concentration (Selby, 2002). It is one of the rare types of exercise that can enhance coordination, balance, flexibility, and muscular endurance (Cozen, 2000). Furthermore, there are few studies in the literature that examine the effects of Pilates exercises on anthropometric characteristics such as body weight, body mass index, and body composition (Segal et al., 2004; Touche et al., 2008).

The Pilates exercise method, developed by Joseph Hubertus Pilates, originated in Germany approximately one hundred years ago during World War I. It is a mind and body-centering technique based on achieving lumbopelvic stability (Muscolino & Cipriani, 2004). In 1923, Joseph Pilates brought this exercise method to America and expanded it, drawing influence from gymnastics, yoga, and dance (Segal et al., 2004). Initially, he named his method the "art of control", or muscle control (Kloubec, 2010). He was inspired by and combined elements from philosophy, gymnastics, martial arts, yoga, dance, Zen meditation, and Greek and Roman exercises (Kloubec, 2010; Cruz-Ferreira et al., 2011). The main goal of Pilates exercises is to strengthen the abdominal and back regions equally, creating a solid skeletal structure for the body. This exercise system, which does not strain the body, is particularly beneficial for individuals with joint problems as it increases flexibility. It also significantly prevents the decline in muscle strength and mass associated with ageing (Tekin Demir, 2013).

Pilates is not merely an exercise approach involving randomly selected movements. It is suitable for people of all ages, from 7 to 70. Physical and mental training increases physical strength, flexibility, and coordination while reducing stress, enhancing well-being, and improving mental focus (Isacowitz & Clippinger, 2011). Pilates exercises have positive effects on physical, psychological (mood, attention, motivation), and motor functions (balance, static and dynamic posture, general coordination) (Lange et al., 2000). It is claimed that Pilates improves muscular strength and flexibility, reduces fat percentage in muscles, enhances core muscle strength, mobility, the functionality of movement, body awareness, and sports performance, helps prevent injuries, and positively affects balance, coordination, and blood circulation (Segal et al., 2004).

Pilates uses gentle resistance to develop muscle strength. This is crucial for adults aged 30-80 who have lost 50% of their

strength due to inactivity. However, there is always time to benefit from strength training (Segal et al., 2004).

Pilates Mat Work

Pilates mat work is a type of Pilates performed on a gymnastics mat or mat without any equipment. This practice is the foundation of Pilates and is excellent for a complete body workout. With mat exercises, the abdominal and back regions can be worked and strengthened equally, helping to build a solid skeletal structure (Isacowitz, 2006).

BASIC PRINCIPLES OF PILATES EXERCISE

The basic principles of Pilates exercise are crucial for obtaining both physical and mental benefits.

Breathing

Breathing is one of the critical elements of Pilates training. It facilitates the stabilization and movement of the spine and extremities. Pilates movements enhance the effect of breathing changes, increase lung capacity, and facilitate changes in chest posture, which are significant factors in general cervical and lumbar pathologies (Anderson, 2001).

Moira Stott, who adapted the traditional Pilates movements to the present day, modified the original model of the exercise. When exhaling, the spine undergoes slight flexion; when inhaling, the spine undergoes slight extension, and deep abdominal muscles are engaged during exhalation. It is easier to engage these muscles when exhaling (Boles, 2000).

Core Control

Many studies have shown that the transversus abdominis, multifidus, diaphragm, and abdominal oblique muscles are the key muscles for movement in healthy individuals with a history of lower back pain. Motor control studies and theories related to trunk integrity and stabilization indicate that the contraction threshold of stabilizing muscles ensures safe movement during daily activities (Anderson, 2001).

Effective Integration of Head, Neck, and Shoulder Regions

Increasing awareness of the head, face, neck, and shoulder regions related to the trunk significantly enhances the movement's effectiveness and reduces unwanted energy expenditure. Proper placement of the upper extremities prevents harmful pressures that cause injuries originating from the shoulder joint and surrounding structures (Yakut et al., 2006).

Spinal Alignment

Currently, the hypothesis that well-functioning areas of the body can reduce the stress on regions exposed to both micro

and macro traumas may be supported by the lack of comprehensive research on the balanced distribution of movement between vertebrae. This indicates a need for more research to better understand the complexity of body mechanics and the functioning of the spine (Katayıfçı et al., 2014; Bernardo, 2007).

Correct Position and Posture

Walking while looking down consumes more energy than walking while looking forward. Pilates emphasizes not only maintaining a correct static position but also the importance of performing movements with proper positioning and posture (Aka et al., 2020; Baltacı & Aytar, 2017; Kılıç et al., 2018).

Movement Integrity

In Pilates exercise, correct movement integrity allows the musculoskeletal system to move flexibly while simultaneously balancing the effects on the digestive, circulatory, respiratory, and reproductive systems, as well as mental and emotional health. This holistic approach considers the human body as a complementary whole, contributing to the integrated functioning of physical and mental health. Therefore, in Pilates, correct movement integrity is a concept that encompasses the entire being of a person, including not just the physical body but also the mental and emotional aspects (Rogers & Gibson, 2009; Sekendiz et al., 2007; Boles, 2000).

Body Composition

Body composition can be generally defined as the proportional combination of body fat, muscle cells, skeleton, other organic substances in the body, and extracellular fluids (Zorba & Ziyagil, 1998). While each person has a unique composition, the factors affecting an individual's body composition include gender, age, frequency or lack of physical activity, diseases, muscle structure, and nutrition (Zorba, 2004).

Body Composition

Body composition comprises a proportional combination of fat, bone, muscle cells, other organic substances, and extracellular fluids (Sönmez, 2006). In 1992, Wang et al. divided the organism into five levels: atomic, molecular, cellular, tissue system, and whole body (Figure 1). According to this approach, one can gain insights into body composition by attempting to measure body components at each classification level.

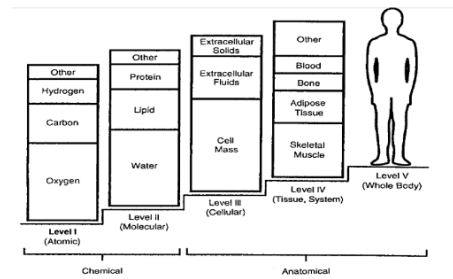


Figure 1: Five-Level Model of Body Composition (Eston et al., 2009)

Atomic Level

The atomic level approach is based on the fact that 98% of the total body mass comprises oxygen, carbon, hydrogen, nitrogen, calcium, and phosphorus. In comparison, less than 2% comprises the remaining 44 elements. Methods used to determine composition at this level include total body potassium counting (K40), neutron activation analysis, and dilution techniques. Due to the exposure to ionizing radiation during measurement in neutron activation analysis, this method is not widely used (Eston et al., 2009).

Molecular Level

The approach to human body composition at the molecular level is based on dividing over 100,000 chemical compounds found in the human body into five fundamental groups: lipids, water, proteins, carbohydrates, and minerals (Eston et al., 2009). Body fat is typically categorized into essential fat and storage fat. Essential fat, constituting approximately 12% of body weight in women and 3% in men, represents the minimum amount of body fat necessary for sustaining physical functions. Storage fat consists of subcutaneous fat under the skin and visceral fat around organs (Dunford & Doyle, 2012). The American Council on Exercise defines *obesity* as body fat percentage, with levels above 32% for women and 25% for men considered obese, while average body fat percentages should ideally range from 25-31% in women and 18-24% in men.

Approximately 60% of total body weight in an average adult is comprised of body water. Total body water is theoretically divided into two compartments: intracellular (within the cells) and extracellular (outside the cells). Thirty-three per cent of total body water is found in the extracellular area outside the cell membrane (8% plasma and 25% interstitial fluid). In contrast, 67% is enclosed within the intracellular area surrounded by the cell membrane (Gropper & Smith, 2013). Despite significant variations in fat and carbohydrate ratios across different populations worldwide, proteins generally provide between 8% and 16% of dietary energy. In healthy adults, proteins constitute approximately 15.1% of body mass (Wang et al., 2003). In more affluent societies, dietary energy typically consists of about 12% to 15% from

proteins, 30% to 40% from fats, and 50% to 60% from carbohydrates (WEB1, 2024).

While the molecular level categorizes human body composition into five fundamental groups, practical methods used to evaluate body composition often combine these groups. A two-component body model examines body weight as the total fat tissue and fat-free body mass. In contrast, in a three-component model, body weight includes fat tissue, fat-free body mass, and bone mineral content (Sital et al., 2002).

Methods Used for Determining Body Composition at the Molecular Level include body density, skinfold thickness measurement, DEXA (Dual-energy X-ray absorptiometry), BIA (Bioelectrical impedance analysis), and nitrogen neutron activation analysis (total body protein), isotopic dilution (total body water) method (Eston et al., 2009).

Cellular Level

The approach that the human body consists of cells, extracellular fluid, and extracellular dissolved substances (solid) is based on (Kir et al., 2000). Cells consist of different groups, such as adipocytes, myocytes, and osteocytes. There is no direct method to measure total cell mass. Extracellular fluid consists of intravascular plasma and extracellular fluid (interstitial fluid). This is mainly made up of water and functions as a medium where gases, nutrients, and waste products are exchanged. This can be measured by the isotope dilution method. Dissolved extracellular substances, such as collagen and elastin fibres, contain organic and inorganic matter found mainly in the bone. Although there is no direct measurement method, many components can be measured with neutron activation analysis (Eston et al., 2009)

Whole Body Approach

The whole-body approach considers the body a single unit characterized by its overall size, shape, surface area, and density, which are most readily measurable (Eston et al., 2009). This approach divides the body into segments: limbs, trunk, and head. Anthropometric measurements such as circumferential measures, skinfold thickness, and length measurements determine the trunk and limbs. Waist circumference measurement is a significant anthropometric measure closely associated with morbidity and mortality related to obesity (Shen et al., 2005). The American National Health and Nutrition Examination Survey (NHANES) highlighted the use of waist circumference data in assessing cardiovascular disease risks, emphasizing that abdominal fat accumulation is linked to hypertension, type 2 diabetes, cardiovascular diseases, gallstones, arthritis, and certain types of cancer. According to World Health Organization (WHO) data from 2008, a waist-to-hip ratio exceeding 0.83 in women

and 0.96 in men indicates increased overall disease risk and obesity (World Health Organization, WHO, 2024).

Body Mass Index (BMI), calculated by dividing body weight in kilograms by height in meters squared, is a simple, inexpensive, and non-invasive method commonly used to classify underweight, overweight, and obesity in adults (O'Donnell, 2008). The WHO classification of adults based on BMI is provided in Table 1.

Table 1. Assessment of body weight according to BMI (kg/m²)

BMI Range	Category
Below 18.5	Underweight
18.5 – 24.9	Normal weight
25.0 – 29.9	Overweight
30.0 and above	Obesity

Factors influencing body composition include age, gender, muscle, physical activity, diseases, and nutrition (Karlı, 2006). In other words, the relationship of body composition components varies with age, gender, ethnic origin, and body shape (Norgan, 2005). Regular physical activity is crucial in maintaining health and preventing chronic diseases. Numerous adaptive responses occur with regular physical exercise, resulting in more efficient oxygen delivery to muscles and substituting carbohydrates with lipids. Reduction in adipose tissue mass increases the mechanical efficiency of movements (Görner et al., 2009).

Physical activity leads to positive changes in body weight and composition. It plays a crucial role in preserving lean body mass, which consists of fat-free body mass and essential fats, by reducing body fat (Peterson & Tucker, 2008). Conversely, physical inactivity significantly increases body fat (Kemmler, 2010). Exercising education is an economically feasible, non-pharmacological approach that promotes beneficial effects on body composition and reduces the risk of cardiometabolic diseases (Irving et al., 2008).

Used Tools And Equipment

Reformer: The Reformer, invented by Joseph Pilates, is a sliding carriage with bars and ropes that works against spring resistance. Joseph Pilates aimed to achieve safe and effective body workouts without exerting pressure on the joints. One of the advantages of the Reformer is its ability to perform a wide range of exercises with a full range of motion. It is used not only by rehabilitation of injuries but also by seasonal athletes (Grootenhuis et al., 2004). Real Pilates reformers

have four springs, each capable of adding 25 pounds of resistance (Siler, 2006).

Ring: The Ring is the most commonly used equipment to increase exercise intensity and involve upper and lower body resistance in floor work. For example, in the half roll-up exercise, placing the Ring between the knees greatly engages the adductors and makes it difficult to keep the pelvis stable (Stott Pilates, 2004a).

Band: The Band is widely used equipment designed to improve the stability and strength of target muscle groups, increase muscle strain in various modifications, and facilitate body movement in some exercises. It also facilitates the transfer of the body in some movements (Stott Pilates, 2004c).

Mat Pilates: Mat Pilates is an exercise form that utilizes the basic principles of Pilates, typically performed on a Pilates mat. It aims to strengthen the body, increase flexibility, improve balance, and enhance posture. Mat Pilates generally utilizes body weight and can be supported using small equipment (e.g., resistance bands or balls). These exercises strengthen muscle groups while targeting deep stabilization muscles. Mat Pilates can be suitable for every fitness level and offers various applications, from studio classes to home practice (Stott Pilates, 2004a).

Conclusion and Discussion

Pilates exercises can reduce chronic pain and discomfort and enhance strength and flexibility, making it not just a fitness exercise performed in specialized centres but a lifestyle. Starting with a solid foundation, Pilates involves posture assessments, addressing problematic areas of the body, and progressively increasing the difficulty level through various exercise series.

In a study by Blum (2002), Pilates exercises were administered to a 39-year-old female participant with scoliosis who had previously limited physical activity. The study demonstrated that while some symptoms persisted, they did not hinder physical activity. Additionally, research conducted by Jago et al. (2006) involving 30 girls aged 11 who performed Pilates exercises for 1 hour, five days a week for four weeks, showed significant reductions in their body mass index.

Pilates routines focus on core conditioning and muscle stretching and strengthening. Core conditioning, known for improving trunk stability and balance, holds particular importance for the elderly, considering that one in three individuals over 65 are prone to falls (Stott Pilates, 2004c; Merrithew et al., 2004). Another study by Segal et al. (2004)

involving 45 women and two men performing Pilates mat exercises for 2, 4, and 6 months found increased flexibility but no significant change in body composition.

Research led by Michele Olson, PhD, supported by the American College of Sports Medicine (ACSM) Health & Fitness Summit, highlighted the health benefits of Pilates techniques and aimed to increase knowledge about them. According to a study from Tufts University published in the *New England Journal of Medicine* in 1994, elderly individuals following such an exercise program increased their strength by 113% in just ten weeks (Stott Pilates, 2004c; Merrithew et al., 2004).

Pilates is beneficial for improving flexibility, muscular fitness, and endurance, particularly for intermediate and advanced practitioners. However, it may have limited potential for increasing cardiovascular fitness and reducing body weight (Dickey & Henkel, 2005). In another phase of Olson and colleagues' study, abdominal muscle activity during Pilates mat exercises was measured. Participants performed 5 Pilates abdominal exercises followed by simple crunch movements for comparison. The results indicated that most Pilates exercises engaged the rectus abdominis muscle similarly in the central abdomen. However, the teaser and roll-up exercises significantly challenged this abdominal muscle more than the crunch. The external oblique muscles on both sides of the abdomen were notably more engaged in all Pilates exercises than the simple crunch, with the criss-cross exercise proving most effective for the external obliques. Additionally, the teaser exercise involved significant activation of hip flexors, making it a preferred exercise for advanced individuals or athletes (Dickey & Henkel, 2005).

In another study by Herrington and Davies (2005), 12 asymptomatic female participants performed Pilates exercises, while another 12 did abdominal curls, with 12 serving as a control group. Those engaged in Pilates exercises showed better results in the Transversus Abdominus (TrA) isolation and lumbopelvic stability tests.

Ersoy (2008) investigated the effects of walking and Pilates on middle-aged women's body composition. Eight subjects in the Pilates group performed exercises twice a week for one hour, significantly reducing weight, body mass index, body fat percentage, waist circumference, and hip circumference after eight weeks.

Baylan (2008) explored the effects of Pilates exercises on basal metabolism and body composition in different age groups (40-50 years, 18-25 years). Significant decreases were observed in circumferential measurements, waist-hip ratio,

and skinfold subcutaneous fat values among the 40-50 age group, while changes were not significant in the 18-25 age group.

Studies evaluating the effects of Pilates exercises on body composition in larger populations are warranted. Furthermore, the late-stage effectiveness of Pilates exercises can be explored. Additionally, investigations into the impact of Pilates on body composition or metabolism in individuals with musculoskeletal problems or metabolic diseases other than healthy subjects could provide further insights. Populations with varying levels of body fat accumulation, such as the elderly, athletes, and obese individuals, could also be studied. Nonetheless, physiotherapists can implement Pilates training as a preventive and health-enhancing approach, considering its positive effects on body composition.

Recommendations

Further research is needed to examine the effects of Pilates exercises on body composition in larger population groups. Additionally, the late-stage effectiveness of Pilates exercises should be explored. Moreover, similar studies can investigate the impact of Pilates on body composition or metabolism in individuals with musculoskeletal problems or metabolic diseases other than healthy subjects. Additionally, populations with different levels of body fat accumulation, such as the elderly, athletes, and obese individuals, should be studied. Despite these considerations, physiotherapists can implement Pilates training as a preventive and health-enhancing approach, considering its positive effects on body composition.

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