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COMPARISON OF BALANCE, FLEXIBILITY, AEROBIC CAPACITY AND AGILITY PERFORMANCES IN HEALTHY WOMEN WHO DO RECREATIONALLY AND REGULARLY CLINICAL PILATES EXERCISE AND REGULAR SWIM

MASTER'S THESIS

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APPROVAL

This thesis has been deemed by the jury in accordance with the relevant articles of Yeditepe University Graduate Education and Examinations Regulation and has been approved by Administrative Board of Institute with decision dated ..... and numbered .....

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DECLARATION

I hereby declare that this thesis is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person, nor material which has been accepted for the award of any other degree except where due acknowledgement has been made in the text.

24/10/2022

KÜBRA PAÇACI

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ABSTRACT

PAÇACI K. (2022). Comparison of balance, flexibility, aerobic capacity and agility performances in healthy women who do recreationally and regularly clinical Pilates exercise and swim. Yeditepe University, Institute of Health Sciences, Department of Sports Physiotherapy, Master Thesis. Istanbul.

Pilates is an exercise modality which is a contact-free, home-based, one-to-one and online opportunity and we aimed to compare the effects of clinical Pilates and swimming exercises modalities on physical fitness parameters in healthy women. A total of 30 female participants (n=30, mean age 25,53±3,37 years) were involved in this study. To compare the differences, participants were divided into three groups as; an intervention group A (n-10, mean age 25,30±3,52 years), an intervention group B (n-10, mean age 25,80±3,58 years) and a control group (n-10, mean age 25,50±3,02 years). While the participants in the intervention group A involved with a Pilates exercise program (PG), intervention group B received swimming exercise program (SG) for 45-60 minutes a day, 3 days a week for 8 weeks and control group (CG) remained sedentary during this time. To compare the differences between and within the groups, aerobic capacity (endurance), balance, agility and flexibility measurements were evaluated before and after the exercise program for each group. Also, Y Balance Test, Stork Stand Test, Sit and Reach Test, 20m Shuttle Run Test and Hexagon Test were assessed before and after the interventions. As the results revealed a nonparametric distribution, the difference of means of the intergroup was analyzed by Kruskal-Wallis H Test, intergroup analysis before and after the exercise program were analyzed by Mann Whitney U Test, intragroup analysis before and after the exercise program were analyzed by Wilcoxon Paired-Sample Test. The significance value was taken as $p<0.05$. The PG had superiority in balance and flexibility changes according to SG and CG. In the SG, there was a superiority in aerobic capacity and agility changes according to the PG and CG. The PG and SG had no superiority in some post-test parameters according to CG. Depending on these results, both of these exercise modalities are effective to increase some physical performance parameters when compared with the control group. However, when it is aimed to increase all those parameters Pilates exercise and swimming could be applied together.

Keywords: *Aerobic Capacity, Agility, Balance, Clinical Pilates, Flexibility, Healthy Individual, Physical Fitness, Recreational Exercise, Swimming Exercise*

ÖZET

PAÇACI K. (2022). Rekreasyonel olarak düzenli klinik Pilates egzersizi yapan ve düzenli yüzen sağlıklı kadınlarda denge, esneklik, aerobik kapasite ve çeviklik performanslarının karşılaştırılması. Yeditepe Üniversitesi, Sağlık Bilimleri Enstitüsü, Spor Fizyoterapisi Bölümü, Yüksek Lisans Tezi. Istanbul.

Pilates, temas gerektirmeyen, ev temelli, bire bir ve online imkan sunan bir egzersiz yöntemidir, ve biz sağlıklı kadınlarda klinik Pilates ve yüzme egzersizlerinin fiziksel uygunluk parametreleri üzerindeki etkilerini karşılaştırmayı amaçladık. Bu çalışmaya toplam 30 kadın katılımcı (n=30, ortalama yaş 25,53±3,37 yıl) dahil edildi. Farklılıkları karşılaştırmak için katılımcılar; müdahale grubu A (n-10, ortalama yaş 25,30±3,52 yıl), müdahale grubu B (n-10, ortalama yaş 25,80±3,58 yıl) ve kontrol grubu (n-10, ortalama yaş 25,50±3,02 yıl) olmak üzere üç gruba ayrıldı. Pilates egzersiz programı (PG) uygulanan müdahale grubu A'daki ve yüzme egzersiz programı uygulanan müdahale grubu B'deki katılımcılar 8 hafta boyunca haftada 3 gün, günde 45-60 dakika eğitim aldılar ve kontrol grubu (KG) bu süre içinde sedanter kaldı. Gruplar arasındaki ve grup içindeki farklılıkları karşılaştırmak için her grup için egzersiz programı öncesi ve sonrası aerobik kapasite (dayanıklılık), denge, çeviklik ve esneklik ölçümleri değerlendirildi. Ayrıca egzersizlerden önce ve sonra Y Balance Test, Stork Stand Test, Sit and Reach Test, 20m Shuttle Run Test ve Hexagon Test uygulandı. Sonuçlar parametrik olmayan bir dağılım gösterdiğinden, gruplar arası ortalamalar farkı Kruskal-Wallis H Testi ile analiz edildi, gruplar arası analizler egzersiz programı öncesi ve sonrası analizler Mann Whitney U Testi ile analiz edildi, grup içi analizler egzersiz programı öncesi ve sonrası Wilcoxon Paired-Sample Testi ile analiz edildi. Anlamlılık değeri $p<0.05$ olarak alındı. PG'de denge ve esneklik değerlerinde SG'ye ve CG'ye göre daha fazla artış gözlemlenmiştir. SG'de ise aerobik kapasite ve çeviklik değerlerinde PG'ye ve CG'ye göre daha fazla artış gözlemlenmiştir. PG ve SG, CG'ye göre bazı test sonrası parametrelerde üstünlüğe sahip değildi. Bu sonuçlara bağlı olarak her iki egzersiz yöntemi de kontrol grubu ile karşılaştırıldığında bazı fiziksel performans parametrelerini artırmada etkilidir. Ancak tüm bu parametrelerin artırılması hedeflendiğinde pilates egzersizi ve yüzme birlikte uygulanabilir.

Anahtar Kelimeler: *Aerobik Kapasite, Çeviklik, Denge, Esneklik, Fiziksel Uygunluk, Sağlıklı Birey, Klinik Pilates, Rekreasyonel Egzersiz, Yüzme Egzersizi*

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1. INTRODUCTION AND PURPOSE

People have sought ways to keep their bodies healthy and strong throughout their lives. For this, a strong and intactus spine, strong muscles supporting it, joints that move freely without restricting the angle of motion, and a strong and flexible muscle structure is required. New research and considerations for spine health have highlighted the importance of keeping the spine stable in its natural position. Today, when the spine is in its natural position with its natural springs, this is known to be the best spinal position for pressure absorption and weight bearing. It emphassized the importance of strengthening the deep muscles around the pelvis and spine to keep the natural position stable. One of the ways to achieve this is Pilates exercises (1). Pilates is a fitness regimen in which floor exercises are used to shape the body, improve balance and coordination, increase flexibility, and provide resolution between mind and body, as well as equipment used to provide resistance (5, 16).

Physical fitness is not only sport-specific, but also includes health-related components. In this framework, physical fitness is evaluated in two ways. The health-related physical fitness; includes aerobic endurance (cardiovascular fitness), muscular endurance, flexibility, strength, and nutrition/body composition. Physical fitness related to sports; In addition to health-related components, it includes explosive strength, power, speed, agility, coordination, balance, reaction time and other abilities associated with a particular discipline. Regular physical activity helps to improve health and reduce the risk of mortality (2).

Various exercise programs are recommended to increase physical fitness. One of them is water exercises. Water has been used as a therapeutic medium since ancient times. Today, exercises done in water are shown as an effective treatment modality and recreational activity for both healthy and sick individuals. Water allows to move in three dimensions, to perform activities without carrying weight, and to make most movements that cannot be done on land possible. Training in water improves cardiovascular fitness, muscular strength, muscular endurance and flexibility (2).

Regular aerobic physical activity increases physical fitness and exercise capacity. Çolak, in their study, compared the effects of aerobic exercise and in-water exercises on

physical fitness parameters in healthy individuals. Muscle strength, muscular endurance, flexibility and power parameters were increased in both groups (2, 3).

Flexibility is an important element of physical fitness, but is often overlooked. Flexibility; It is defined as the facility of movement around a joint. Lack of physical activity is the biggest cause of inflexibility. Exercise increases flexibility (3).

Cardiovascular endurance shows how efficiently the lungs, heart and blood vessels are working, providing the necessary oxygen to the working muscles. Cardiovascular fitness can be defined as a person's capacity to use oxygen during physical activity. Cardiovascular fitness is associated with the ability of large muscle groups to sustain dynamic, moderate and high-intensity exercise for a long time. A good level of cardiovascular fitness depends on the functional state of the respiratory, cardiovascular and skeletal musculature. Cardiovascular fitness is an indicator of good health (2).

Agility is defined as the ability to quickly change the direction and position of the body (2).

Balance; maintaining the appropriate relationship between the body, body parts and the environment, keeping the body's center of gravity on the support surface while performing an activity. It can be divided into two classes as static balance and dynamic balance. Static balance; It is the ability to stay in balance in a fixed position. Dynamic balance; It is the ability to maintain balance during movement (2).

Pilates routines focus on core conditioning and muscle stretching and strengthening. Core conditioning is commonly known as trunk stabilization and improves balance. Considering that one out of three people over the age of 65 falls each year, this issue is important for the elderly (80).

In the literature, there are studies investigating the effects of clinical Pilates exercises on physical fitness, performance and body composition on healthy individuals. In this context, the effectiveness of Pilates exercises was compared with the control groups. As a result of the studies, it has been shown that Pilates exercises have recently become a very effective and popular approach in rehabilitation and exercise programs to improve physical fitness and performance (1, 3, 4, 5).

In the literature, there are few studies investigating the effect of water exercises on performance and physiological parameters. As a result of the studies, it has been shown that the exercises performed in water improve performance parameters such as cardiovascular fitness, muscular strength, muscular endurance, and in this context, it is used as an effective treatment modality and recreational activity today (2). To the best of the authors knowledge, there is no study comparing the effects of the Pilates exercise method with swimming or in-water exercises on physical fitness parameters. As a result of this research, it is aimed to answer the question of how the development of physical fitness performances is affected by swimming exercise and clinical Pilates exercises in healthy women.

When the studies on the issue were examined, it was seen that swimming exercise was mostly related to respiratory functions and physiological measurements. There are few studies which the effect of swimming on physical fitness parameters in adolescents. On the other hand, although physical fitness parameters are an important factor in all sports activities, this issue is limited in studies related to swimming (108).

Swimming is an activity that has been done for the purpose of protection from wild animals, protection from water accidents, food supply, body beauty, homeland defense and pleasure since the first humans. The first swimming movements in the modern sense started in swimming pools opened in London. Swimming is an Olympic sport that has an important audience in the world (108, 109).

Swimming is a very suitable form of exercise for health promotion and disease prevention and is one of the most popular, practiced and recommended forms of physical activity (17). Swimming, which is the coordinated and harmonic movement of the human body in a fluid environment with the combined movement of the upper and lower limbs, is a physical activity practiced by healthy and unhealthy people all over the world. Swimming is one of the less contraindicated physical activities and can be recommended for individuals of both sexes and all ages, including the most advanced age, with limited exceptions (18).

Swimming is the rare sport to be recommended in more than 80% of the medical cases and to have a large target audience, accessible to both children and the elderly. From a psychological perspective, swimming reduces the mental tensions and anxiety, caused by everyday stress and the competition one, while avoiding hostility and frustration in

life, in a beneficial way. Swimming is ideal for adults, as it includes minimal stress and weight-bearing and low thermal load (111, 112). At the same time, swimming exercise is a very preferred sport because of the soothing effect of water and its effect on improving physical and physiological parameters. But today, people could not find the opportunity to access the pools due to the Covid-19 pandemic. Because the pools were closed, due to some bans and hygienic problems. In addition, the number of people who do not know how to swim, are afraid or do not want to swim for any reason is at a level that cannot be underestimated. Therefore, an exercise deficit emerged that could improve performance equivalent to swimming. This has led people to sports like Pilates, which mostly does not require contact, offers home-based, one-to-one and online opportunities. Similar to swimming, Pilates is used for sedative purposes, due to be included breathing patterns in combination with movement, flowing movement patterns, and minimal weight bearing. In addition, the effect of two sports on muscle strength is known. Recently, Pilates has been one of the most preferred sports branches owing to the increasing need with the consequences of the Covid-19 pandemic (91, 110).

For these reasons, we aimed to investigate the effects of these exercise modalities, which are seen to have similar characteristics in the light of these studies in the literature, on physical fitness parameters in healthy women. We believe that this study, which was designed as an experimental research and descriptive study, will contribute to the rehabilitation programs of healthy individuals and patients, physical fitness education, congress presentations and literature. This study will especially explain how Pilates exercises will affect performance parameters compared to swimming exercise. In this way, it is aimed to contribute to the exercise programs used in rehabilitation and to the literature.

This thesis will determine whether clinical Pilates exercise and swimming are equally effective in improving physical fitness performance parameters and thus offer an alternative exercise option to each other. If clinical Pilates exercises can be as effective as swimming for physical fitness performance parameters in healthy people, this method can be recommended to people who cannot swim.

In addition, in Covid-19 pandemic, clinical Pilates exercises can be used as an easy and inexpensive self-administered exercise method at home to improve physical

fitness performance. As a result, no other study similar to this study was found in the literature.

This study, which will be carried out as a master's thesis, has been designed as experimental research and a descriptive study. The study will be carried out in the Fizyoroyal Physical Therapy Clinic, with the aim that the sample will consist of healthy women.

In this study, it is aimed to answer the question of whether there is a significant difference between the effects of clinical Pilates exercises and swimming exercise on the development of physical fitness performance in healthy women. The aim of the study is to determine and compare the effects of the two exercise methods on physical fitness parameters (balance, flexibility, aerobic capacity (endurance) and agility) in order to reveal any superiority between clinical Pilates exercises and swimming exercise methods in healthy women.

Two hypotheses identified in the study:

H_0: In healthy individuals, clinical Pilates exercises have no more effect on the development of physical fitness parameters than swimming exercise.

H_1: In healthy individuals, clinical Pilates exercises have a higher effect on the development of physical fitness parameters than swimming exercise.

This research study will be a comparative study comparing two different exercise methods.

- **What is thesis question?**

Can Pilates exercises be recommended instead of swimming when necessary?

2. THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1. Sport

Although the sport, which has been encountered in written sources since the existence of mankind, is carried out for physical activity and entertainment today, it was used to prepare individuals for wars in the past (16).

Today, sports activities can be carried out in a wide variety of environments and conditions by using the necessary equipment. Sports activities performed in various natural conditions or facilities are important in terms of increasing the health and quality of life of the individual (16).

The word sport is translated into Turkish; It comes from the word “sport”, which means the same thing in French and English. The origin of the word sport is derived from the ancient French word “desport”, which means to linger, have fun, play (Etymology Dictionary 2019) (16).

As it can be understood from the etymology of the word sport, activities performed as distraction, entertainment, and games enable a more serious working environment to be created, thanks to the equipment innovation that has been brought with it by the technology that develops in both professional and daily life over time (16).

Sportive activities, which positively affect individuals, both mentally and physically, also contribute to the social life of the individual. In addition to the professional sports activities carried out on an international scale, study halls have been established where individuals can exercise. In addition, there are opportunities for sports activities with alternative resources that individuals from all walks of society can access so that they can be carried out in various natural conditions (16).

2.1.1. Definition of Sport

The word sports are defined by the Turkish Language Association as "All the movements performed in accordance with some rules, individually or collectively, in order to improve the body or the mind" (TDK 2019) (16).

Sport is a set of activities performed by licensed amateur and professional athletes by knocking out the opponent within the framework of certain rules. It is a cultural and

social concept that is performed individually or in groups, as a leisure activity or as a profession, in accordance with certain rules, with or without a vehicle, which socializes the individual, develops the spirit and physique, provides and develops cooperation and solidarity based on competition. Physical activities such as walking, playing games, cleaning the house, cycling, skating, dancing or climbing stairs constitute an integral and important part of daily life (20).

Sport, which is a cultural and social concept, is carried out in order for individuals to develop themselves in every sense. Sports performed as a professional or amateur allow the individual to reach the level of full saturation physically, spiritually and socially (16).

Sports activities are the whole of the effort made in order to increase the current strength of the individual as much as possible and to raise it to the highest level in order to be able to fight and be excited in accordance with the existing rules of the activities carried out, to be victorious as a result of the competition and to achieve the targeted success, in order to protect and raise the physical and mental health of the individuals (21).

Sports activities carried out within the framework of the necessary rules also teach the concept of discipline to individuals, allowing them to act on this discipline process in their lives and to achieve the desired success or results in the individual's private life, allowing the level of satisfaction (16).

When we look at sports activities individually, it is possible to define it as a tool that can distract individuals from their daily problems in their lives, enable them to explore their physical and mental abilities and lead a more productive life. Especially with the development of technology and the adaptation of modern life to it, the increasing stress parameter in individuals, the increase in health problems brought by contemporary life, such as obesity, the increasing anxiety of individuals due to socio-economic conditions can be said as the daily problem of today's people. It can be said that individuals engaged in sports can produce temporary or permanent solutions to such problems by performing physical activities. When sports activities are examined from a social point of view, it can be mentioned that it allows to increase socialization, thus protecting public health and making people more emotionally resilient. Among the other advantages are the contribution of sports activities to the existence of societies, which allow countries to gain employment opportunities in the international arena and gain

prestige as a result of the establishment that emerged in order to carry out sports activities within the facility as economic benefits (22).

It has been observed that individuals get away from daily problems and stress while dealing with sports activities and contribute to their daily lives thanks to the concept of quality time they allocate for themselves. It is a known fact that thanks to sports activities, individuals also contribute to their socialization by being in a social environment (16).

In addition, its contribution not only to individuals, but also to society and countries is undeniable. Facilities established for the purpose of carrying out sports activities also contribute economically by providing employment and enabling them to participate in international competitions. Thanks to the sports activities of the individual, gaining strength both emotionally and physically increases her/his productivity in the business environment (16).

2.1.2. Benefits of Sport

The demographic structure of individuals, their achievements, physical structures, the ethnic structure of the society they live in, and the communication skills they establish with their environment are the most important factors that determine the place of individuals in social life. Sports activities have an effect on all these factors thanks to their physical effects (16).

As a result of the researches, the effects of sports on psychological health as well as physical health of the individual focus on four situations. These four effects can be stated as follows;

- Mood
- Fear
- Depression
- Self Design

The fact that sports activities allow physical improvement in terms of appearance and the positive effect on self-esteem as a result of the emergence of the individual's physical satisfaction states that such activities have an indirect positive effect on the psychological health of individuals (23).

It is a known fact as a result of researches that if individuals do sports physically, their self-confidence is restored by having a good appearance and thus contributing psychologically. Various ministries have started to be established in order to evaluate and develop sports activities more systematically by countries. Thanks to these ministries of sports, countries can participate in sports competitions organized in international arenas and allow the official records to follow exactly the importance that countries attach to sports activities (16).

It constitutes one of the building blocks of the modernization path in the age of developing technology, thanks to the fact that sports activities quickly become a social institution and contribute to education, economy and international diplomacy (24).

The high level of performance and innovation understanding of the employees present in the institutions and organizations serving on the management of sports activities stands out as a factor that increases the importance of the controls of these institutions and organizations (16).

2.2. Physical Activity

Physical activity by the General Directorate of Public Health affiliated to the Ministry of Health; "It is the movement of the body to spend energy. Physical activity can be all of the basic body movements such as

- Running
- Jumping
- Swimming
- Cycling
- Squatting
- Standing Up
- Arm and Leg Movements
- Head and Body Movements

Which increase the heart and respiratory rate with energy consumption by using the muscles and joints in daily life and result in fatigue at different intensities. It is defined as various sports branches, dance, exercise, games and activities during the day" (Ministry of Health 2018) (16).

Physical activity is the whole of activities that cause individuals to spend energy at various rates in daily life without being tied to a certain system and order. Individuals often consider the definition of physical activity synonymous with exercise and sports. However, physical activity is defined as activities that reveal energy consumption by using the muscles and joints in daily life, are applied at various intensities, and subsequently cause an increase in heart and respiratory rate, resulting in fatigue. While exercise and physical activity have been used synonymously until recently, the definition of exercise has been started to be defined as a sub-category of physical activity as a result of research conducted in recent years. Exercise is the whole of physical activities performed with planned and regular repetitions that ensure the preservation of body fitness (20).

Until recently, the concept of seeing exercise and physical activity as synonyms has changed. In order for physical activities to be called exercise, they must be carried out regularly, systematically and in a certain process. Thanks to this decomposition, the interaction process of the parameters of the quality of life of individuals can be revealed more clearly. There are physiological, social and psychological effects, according to the rate of physical activities (16).

2.2.1. Physiological Effects of Participation in Physical Activity

Physical activity is important to lose a healthy weight or maintain a weight that is appropriate for the body mass index, to maintain the physiological balance of the body, especially the digestive system, to proportionate bone density, to increase muscle strength and joint mobility, and to strengthen the immune system. Studies have proven that physical activity can improve quality of life. It has been found that the life span of the individuals who do physical activity at certain levels of intensity, especially at the rate of moderate and high intensity, is lower than those who do not perform any activity. Physical activity is among the findings that it prevents aging and improves the quality of life by keeping the body vigorous. In the researches, it is stated in the statistics that individuals who do not perform physical activity are more likely to catch chronic diseases and cause preterm birth at a rate of 9 percent worldwide (25).

Performed daily physical activities protect individuals from many of the chronic diseases. The fact that the diseases are evaluated in terms of risk according to the rates of

physical activities associated with health in the studies carried out, it is important to direct the individuals accordingly (16).

When physical activity, which is defined as at least moderate, is performed, very good reactions have been observed in the level of resistance of individuals against chronic and sometimes fatal diseases, the rate of recovery and reducing the existing risk. The daily physical activities of individuals, which are detailed as at least moderate level, help to increase the quality of life considerably (16).

2.2.2. Social Effects of Participation in Physical Activity

In addition to the effects of physical activity on individual health, it also has a positive psychological and social effect. Social influences;

- Activation of feeling good and happiness hormone,
- Developing positive thinking and improving the ability to cope with both daily and general stress
- High social cohesion and adaptation of the individual

In addition, it allows individuals and society to meet all the conditions present in the definition of health (26).

Physical activity, which helps the individual to gain respect for his/her self-identity, enables a more active and productive life in social life. Socially, increasing productivity in the business environment allows the individual to reach their goals more easily and quickly, to increase their self-confidence, and to interact with people as desired.

In this way, the social development of individuals, thus being happier and healthier, contributing to the society and their country can be called the social contribution of physical activity (16).

2.2.3. Psychological Effects of Participation in Physical Activity

When the literature is reviewed in the studies, it is seen that studies that evaluate physical activity and quality of life are mostly performed in groups with sick individuals (cancer, heart disease, diabetes mellitus, cerebral palsy, etc.). While some of these studies are carried out directly in line with the quality of life parameters, it is seen that some of them are based on quality of life and the scales (mental well-being, perceived health, general health, etc.) are used to determine this quality. In a systematic study conducted

on patients with chronic heart disease, it has been proven that short-term physical activities have positive psychological benefits on patients. In the study of Benno et al., who carried out such studies, it was stated that exercise has a great importance on clinical exercise capacity and quality of life (27).

Especially as a result of research on individuals with certain types of disorders, physical activities allow the psychological effect on the individual's existing discomfort to be minimized (16).

As a result of the creation of the body, the movement of the individual is generally coded. This coding remains unrequited under the conditions of this age as a result of developing technology. It cannot be expected that the psychology of individuals who have lost their health will be correct in direct proportion. The most important factor in the treatment of ailments is morale, and physical activities increase the individual's current morale. In this way, the treatment process of the disease can be accelerated or the emergence of this ailment can be prevented (16).

It has also been scientifically proven that many of the diseases of this age are psychological. Individuals who perform physical activity secrete serotonin, thereby activating the hormone of happiness, resulting in healthier individuals (16).

2.3. Health Concept

Health is defined by the Turkish Language Institute as “the individual's being in a state of complete physical, social and spiritual well-being, bodily well-being, health, wellness, welfare” (TDK 2018).

The definition of health by the World Health Organization is; “Health is not just the absence of disease and infirmity, but a state of complete physical, mental and social well-being” (Turkish Medical Association 2018).

Both the Turkish Language Institution and the World Health Organization accept the individual's physical and mental health within the definition of health. Just being physically healthy is not completely acceptable for health conditions. Being mentally and spiritually healthy means that an individual is within the scope of full health. Criteria such as place of residence, environment, financial adequacy, social area should be taken into consideration.

The content of the definition of the World Health Organization is generally accepted. Health, which is determined in relation to the basic existence of human beings, is not only defined as physical health, but is also evaluated together with the part of the conditions and opportunities that fall on that individual in relation to the situation of the societies. The terms "communal" or "social" in the definition of the World Health Organization seem to be defined with a broad perspective of meeting the cultural, economic, etc. needs of individuals' political well-being (28).

The good mental health of the individual primarily depends on external factors. In case of deterioration of mental health, it also affects the physical health of the body. For this reason, communal and social well-being of individuals is important in terms of general health.

As a result of the researches, it has been proven that exercising is not only good for the physical health of the individual, but also for the mental health. In various studies carried out on this subject, it is known that the mental state of the individual improves as a result of the exercise she does, and at the same time she begins to feel better physically.

The concept of health covers a very important area within the framework of general life. Shaping the life of the individual requires that she/he be healthy and develop in this direction. Getting efficiency from the work one does and getting efficiency from one's life includes all of these. State authorities carry out various studies for public health and work on laws on this issue. Health is the most important need in societies. Being accessible and free is published in the World Declaration of Human Rights. The concept of health, which is seen as the most basic need, is still a wide field of study today. Reforms in developing countries allow this concept to improve (16).

2.4. Woman and Exercise

In ancient civilizations, women were not allowed to do sports and it is known that they were forbidden to participate even as spectators. In line with the changes in the environmental and social, cultural characteristics of women today, it is seen that there is a prominent increase in their participation and interest in sports (29).

In the last 15 years, although the participation in sports is very high, the orientation of women in sports differs, and the participation of women in sports may be higher in countries with high income and industrialized countries (30).

Regular sportive movements have a great effect on body composition. Studies have shown that individuals who exercise can reduce their body fat percentage. However, as a result of scientific studies, exercises applied in various ways do not show any difference between genders. It has been reported that the effects of exercise in men and women do not change. The differences between men and women are more evident with the data obtained, and male athletes perform better than female athletes (31).

Men are less fat than women. Women are fatter than men. There is fat in both men and women for 3-5% of the body's body mechanisms to work better. In addition to this fat ratio in women, there is 5-8% gender-specific fat (32).

The most common functional disorder in women who do not exercise is known as premenstrual syndrome. This disorder, which is mostly seen in women aged 30 and over, has many markers such as headache, depressive movements, irregular sweating, anxiety, edema and irritability. As a result of this situation, women are adversely affected (33).

2.5. Physical Characteristics of Women

It has been accepted throughout history that there are significant differences between men and women. These differences include the physical and physiological ability to reach maximum potential, gender-specific disabilities, and specific medical conditions related to participation in sports or exercise. Pre-puberty girls and boys have equal body fat and lean body mass. Body mass index in girls is usually between 15 and 18, and there is no significant change in childhood (34).

During prepubertal development, boys and girls have similar growth rates, and 12-year-old boys and girls are, on average, the same height and weight unless serious disease or genetic abnormality is present (35,36).

Although puberty is generally defined as the process of sexual maturation in the human body, important physical, physiological and behavioral changes occur in this process (37).

Several years before sexual maturation, increased secretion of steroid hormone from the adrenal gland and ovaries initiates extensive physiological changes in the body. One of these changes is the growth spurt that occurs in adolescents (38).

This acceleration in growth lasts for about a year, then slows down and ends with the fusion of the epiphyseal regions of the long bones where growth occurs. Estrogen hormone provides epiphyseal fusion in both men and women. While there is an increase in body fat percentages of women during this pubertal transition, this situation is not seen in men. The appearance of the female body becomes very different from that of the male, and the main reason for this is the hormones estrogen and progesterone secreted from the ovaries. Luteinizing hormone and follicle stimulating hormone, which are not secreted in the pre-puberty period, begin to be secreted in this period. Estrogen is secreted from the stimulated follicles and thus causes changes in the body with the growth of the breasts and hips due to the increase in fat storage. In general, the musculoskeletal anatomy of women is different from that of men. There are structural differences between the sexes and these differences are due to both environmental and genetic factors. Men and women have different physical characteristics in terms of height, body weight, body shape, body size, and compatibility of extremities (pelvis width, body mass distribution, ligament and tendon flexibility) (36).

A young woman has about 20% less muscle mass than a man of equal weight. Gender differences lead to a wider pelvis, shorter legs, and lower center of gravity in the development of the skeletal system in women.

These differences increase stability in women, change gait dynamics, and reduce women's mechanical efficiency by increasing the angle of the thigh bone and bringing the knees closer together (39).

Although females are shorter, they have a lower body mass and a different general morphological appearance than males. As a natural result, women's arms and legs are shorter. Men have wider shoulders, women have larger hips, and women have a wider elbow angle. In women, the angle of inversion is wider at the knees (35).

Women differ from men in certain bones and bone characteristics. In women, the entrance and exit of the pelvis are wider, the distance between the joints is longer, the interval between the hip flexors is wider (36).

The pelvis in men is vertically longer, thicker and narrower, but with more muscle mass (40).

2.6. Pilates

Increasing inactivity with today's modern lifestyle causes serious health problems. This situation causes loss of health workforce an, increase in drug and treatment costs and also harms the economy of countries.

It is also important to develop country policies and to introduce practices that encourage individuals to exercise. Exercising is considered an alternative treatment because it protects against diseases caused by inactivity (16).

Developing technology causes individuals to live sedentary along with it. For this reason, it causes physical deterioration of both the muscle structures and body conditions of the individuals in terms of health. For this reason, it is of great importance for countries to direct individuals at the social level to exercise in terms of a healthy life.

According to psychological and physical studies, Pilates exercise is the most detailed exercise type that can be done on the individual.

Defined as a physical fitness system, Pilates was named after Joseph H. Pilates. Pilates, which is accepted as an exercise; By activating every muscle in the body, it provides balance and flexibility and allows the body to give a proper posture. Since these exercises are based on a common basis with treatment and rehabilitation, they can be used together for a long time. Pilates exercise, which has increased in popularity, has started to be used actively in art communities such as stage and dance over time. Pilates exercise is also used after the damage to the muscles because it creates a rehabilitative effect (42).

Since Pilates is important, especially for the development of muscles, it was used primarily in dance communities, and over time, its clinical use has increased due to its rehabilitation effect.

The basis of Pilates exercise, developed by Joseph Pilates, includes movements made with a certain rhythm and focusing on the breath. Pilates exercise is used to increase physical health, psychological health and body motor control, healthy posture of the body. In various researches and literature reviews, Pilates exercise is defined as physical-mental exercises due to the benefits of physical and mental health of the individual (43).

The main purpose of Pilates exercise is to enable the body part of the body to form a solid muscle and skeletal structure by equally strengthening the muscles that are not

active in daily life in the abdomen and back. The main focus of Pilates exercise is to develop the deep muscles in the inner part of the body in the body center and the muscles close to the backbone. Unlike other exercise methods, Pilates exercise provides an integrity to the muscle structure (44).

As a result of the efforts made especially for strengthening the body part and the parts close to the backbone, which Pilates exercise is seen as the body center, various chronic diseases are prevented by gaining an integrity in the body musculature.

In Pilates exercise, unlike other forms of exercise, it is preferable to perform a maximum level of repetitions, but to use these repetitions in a controlled manner. John Pilates created 500 basic exercise studies in accordance with the basic logic of Pilates. Thus, it was aimed to improve mental and physical health through a common exercise method. Fluent movements, breathing, control and concentration were described as basic principles in Pilates exercise. As a result of these studies, it has become certain that the individual's body creates increased flexibility, strength and body awareness, as well as energy and an improved mental concentration. Even today, Pilates exercise has become a form of exercise that physiotherapists actively use, especially in the rehabilitation process, as well as being practiced as a sport (16).

The fact that Pilates exercise can meet the physical and physical health parameters present in the definition of health allows it to be used actively in many respects. Factors such as the Pilates principles increasing concentration in sports, teaching correct breathing techniques, and providing fluent movements in the rehabilitation field increased the interest in this form of exercise intensified.

Joseph Pilates saw fit to call this exercise "the art of control". Pilates aims in this exercise method; The goal of a healthy individual was to have a strong mind and to allow that mind to have complete dominance while controlling his body. Therefore, the methods of Pilates exercise are not only aimed at providing physical strength, but also to create a balance between the mind and the body (45).

The active use of the Pilates exercise of the muscles was called the science of control (Contrology). An intensive exercise program on the muscles supporting the spine is still actively used today. Correct breathing has also become one of the reasons for choosing this exercise (46).

Pilates focuses on maintaining a ‘neutral spine,’ pelvic and spinal stability, along with activation of transverse abdominals and pelvic floor muscles in combination with controlled breathing. These are provided by the control and correct activation of the core muscles. A device called “stabilizer” is used to teach the correct operation of the core muscles, especially the deep neck flexors, the transversus abdominus muscles, and the control of the lumbopelvic posture. The stabilizer device developed by physiotherapist Gwendolen Jull and whose validity and reliability has been proven in the literature; It consists of manometer, hand pump, three-section pressure cell and pressure pins (3, 19).

Figure 1.1. Stabilizer Pressure Biofeedback Unit

The Pilates exercise program, from the beginning to the end, allows the individual to have control over strengthening his muscles in terms of body health, while allowing him to develop mentally, which can fully underline the term "The Art of Control", the idea that Joseph Pilates devised while creating this exercise. It is an important criterion that this exercise, which allows control over the body and control over the mind, also keeps the harmony between body and mind under control.

The Pilates exercise, created by Joseph Pilates, is not just a fashion trend; It has become clear that it is a system whose results have been proven by the studies carried out over time with positive results. There is a definite connection with the "mind-body" harmony, in which the individual gains control over her/his own body. It is supported as a composition of eastern and western style exercises, in which the individual works all her muscles in line with the exercise stages (41).

The system developed by Joseph Pilates is an exercise that is actively used both clinically and as a sport. As a result of the synthesis of Eastern and Western exercise

styles, it can be easily adapted throughout the world. By improving the mind and body unity, it can give the individual all the needs available in the definition of healthy life.

The details of Pilates exercise, which is not only a branch of exercise that is interested in a temporary popularity, are examined below. It has a wide application area, both because it has a wide place in the concept of health and because it develops the basic conditioning system in sports activities (16).

2.6.1. History of Pilates Method

Developed by the German Joseph Hubertus Pilates, Pilates began to be used in the United States in the early 1920s and became a popular exercise technique (47).

Joseph Pilates, who has the same name with this exercise, was born in Germany in the early 1900s and has tried various sports activities to develop and strengthen the body and increase body resistance. Pilates, who was imprisoned during the war, developed a special sports method to help his friends who were weakened due to the epidemic disease called "influenza", which emerged at the same time and caused many deaths. Although Pilates, who settled in the USA after the war, showed interest in this sport technique, especially athletes, ballerinas and models, it later spread all over the world (International Pilates Federation 2018) (48).

He activated Pilates exercise with special techniques for people to improve themselves physically and spiritually due to the diseases that Pilates had as a child and the epidemic that followed and the deaths that followed. After moving to the USA and especially the Pilates exercise, which allows to work in full harmony with the muscles, spine and mentality, it has attracted attention all over the world, especially the athletes.

In Turkey, the implementation of Pilates exercise coincides with the beginning of the 2000s. It can be stated that scientific researches have started to be carried out within the science of exercise regarding the Pilates exercise method, which gained popularity with the implementation of Pilates exercise in some sports centers and the support of the media (49).

In this country, on the other hand, Pilates sport, which has become known with the support of the media and the popular society allowing Pilates exercises to be brought to some sports centers, has been actively used since the beginning of the 2000s.

2.6.2. Benefits of Pilates Exercises

To see changes in overall flexibility and strength, practicing Pilates at regular intervals allows the benefits of Pilates exercise to be fully reaped. For best results, all movements have full speed and duration. On this basis (The Pilates coach 2018) (1,16, 50, 51);

- Increasing all energy
- Increasing athletic performance
- Better concentration
- It improves flexibility with support and allows joints to work in full range of motion.
- Increases endurance and strength.
- It teaches how to take advantage of full and deep breathing during movement.
- Improve breathing
- Developing kinesthetic or movement awareness
- Provide functional movement and balance training
- Improving muscle balance by increasing abdominal muscle strength and flexibility
- Providing lumbopelvic stability
- Restoring hip and shoulder girdle movements independent of pelvis and spine
- Isometric for static and dynamic stabilization in all motion plans
- Develop and coordinate concentric and eccentric muscle synergies and co-contraction
- Improving joint range of motion and muscle strength throughout the entire range of motion (50)
- Improves core stabilization, works from the inside out.
- It creates a longer, thinner, leaner and more balanced body.
- Improves the function of the feet and ankles.
- Corrects the posture.
- It makes life better.
- It establishes the balance between weak parts of the body (51).

Other benefits of Pilates exercises are known to increase circulation, lower blood pressure, better joint mobility and improve posture. Studies have shown that this type of exercise helps cardiovascular diseases, neurological disorders, osteoporosis, arthritis, lower back pain and disability (52).

Pilates routines focus on core (center) conditioning and muscle stretching and strengthening. The abdomen, hips, waist and scapula areas are called the power house of the body. Core conditioning is commonly known as trunk stabilization and improves balance (52).

Pilates uses gentle resistance to build muscle strength. For adults aged 30-80 who have lost 50% of their strength, this is key. But it is never too late to reap the benefits of strength training (52).

Pilates has physical benefits as well as psychological benefits. It helps individuals to look inward. Breathing is emphasized, which helps the brain focus on what the body is doing. Pilates-based exercisers said that the exercises made them feel calmer, more energetic, refreshed and self-aware (53).

Lead researcher Ralph La Forge of Duke University medical center in mind-body fitness has validated the development of scientific evidence supporting mind exercises by significantly altering various health images, particularly mood and cardiovascular risk factors (52).

Michele Olson, Ph. D., there is a misconception that Pilates exercise lengthens and thins the muscles, that the muscles cannot develop longitudinally, but their flexibility increases; He said that the thin tissue in the muscles can be increased without fat, muscle mass can be developed, but it cannot be narrowed (54).

2.6.3. Classification of the Pilates Method

2.6.3.1. Fitness Pilates

Fitness Pilates is applied to increase the general health and functionality of the healthy population. For this reason, classes are often larger than in clinical Pilates. The studio materials used are less costly and the exercises performed are less individualized. Fitness Pilates, which is done for the protection of health and well-being in places where individual and team sports are performed and in gyms, also contributes to the minimization and management of diseases such as low back pain, cardiovascular diseases, obesity, osteoporosis and arthritis (4, 55).

2.6.3.2. Clinical Pilates

Pilates is used as a rehabilitation and treatment method. Pilates used for therapeutic purposes is called clinical Pilates. The basic principle of clinical Pilates activates the stabilizer muscles of the pelvis, spine and neck, reduces pain by strengthening the spine muscles. Clinical Pilates is basically trained by adapting it to the human body and the transverse abdominis. It is aimed to make the movements in a certain principle with breath control by strengthening the body (43).

In addition to being used as sports activities, Pilates is also used clinically. Thanks to the individual's focus on breathing control, it optimizes body health, especially the spine, along with various Pilates exercises (16).

Pilates exercise, in which stretching and strengthening methods are developed, contributes to the creation of a flexible and strong body, as well as a strong mind that aims to control the body. Clinical Pilates is applied in line with comprehensive and various core principles.

Clinical Pilates exercises can be used in rehabilitation programs for the purpose of strengthening at the beginner level, or they can be adapted to the challenging fitness development of a high-level athlete (3).

Clinical Pilates primarily deals with injury rehabilitation. The creator of Clinical Pilates, Australian physiotherapist and former ballet dancer Craig Phillips designed the Clinical Pilates Exercises to regain and maintain muscular strength, flexibility, coordination, endurance, stability and proprioceptive mechanism functionality (55, 56).

Clinical Pilates is used both in sports activities and in cases such as physical damage. The fact that the creator of clinical Pilates is a ballet dancer as well as being a physiotherapist contributed to the development of this exercise. Today, it is known that many physiotherapists use clinical Pilates (16).

2.6.4. Basic Principles of Pilates Exercise

Creating the right movement integrity for various factors that make up the human body is possible with Pilates exercise. Although Joseph Pilates did not explicitly state the principles of his exercises, these principles were drawn from pages of his writings, original film footage, and other archives. The basic principles of Pilates exercise are as

follows; breathing, concentration, central control, control, precision and sensitivity, and slow and fluent movements are considered the basis of this exercise system (Pilates Federation 2018) (4, 16, 48).

2.6.4.1. Breathing

Breathing, which is the basis of Pilates exercise, allows the spine and extremities to be stable and functional. Thanks to Pilates exercise, it facilitates the effect of breathing change, the increase in breathing capacity, and the change of chest posture, which is the main factor in general cervical and lumbar pathologies (1, 16).

Pilates exercise basically starts with breathing. In this way, it allows the rib cage to straighten and the lungs to develop. Thanks to the correct breathing technique, besides physical recovery, it also allows sufficient oxygen to be taken into the body.

Breathing in Pilates exercise should be done by breathing deeply without panic and exhaling completely. The duration of the breath is shaped according to the movements performed (57).

Breathing should be adjusted according to the positions of the movements, and it should be noted that the time is determined accordingly (16).

Figure 2.1. Breathing (57)

2.6.4.2. Concentration

In Pilates exercise, concentration means concentrating on the movements, feeling that the body is working in harmony and paying attention to which muscles are used and which are not (57). Concentration is of great importance in Pilates exercise. Feeling that

one's body is developing and paying attention to it constitutes the basic mentality of this principle (16).

Figure 2.2. Concentration (57)

2.6.4.3. Control

Another important factor is control. In order to provide control in Pilates exercise, the body should be well rested, the movements should be performed in accordance with the original and possible injuries should be prevented (57).

Performing movements with control in Pilates exercise allows to prevent possible discomfort and undesirable results. It is known that a well-rested body can perform movements more easily and properly, and control can be achieved easily (16).

Figure 2.3. Control (57)

2.6.4.4. Precision and Sensitivity

While performing the Pilates exercise, it is necessary to focus on the movements, pay attention to how the body works, which muscles are working, and whether they are used appropriately. Concentration is key in Pilates exercises. At the same time, it provides a relaxing effect, as it helps the body to move in harmony and to feel the correct application of postures, and to distract the brain from daily hustle and bustle (44).

Movements should be done exactly, not ambiguously. Movement sequences must be coordinated within and between each other. In this way, feeling how the body rests and how the muscles are activated provides a mental relief (57).

Figure 2.4. Precision and Sensitivity (57)

2.6.4.5. Central Control

The basic movement in Pilates exercise consists of the body center, belly, waist and hip circumference. Thanks to its central control, it allows the stability and stretching of the musculature that keeps the internal organs and spine in place and also extends it. With this exercise, the basic movement focuses on the center. The musculature that holds the internal organs and the spine together, defined as the center, is meant (57).

Figure 2.5. Central Control (57)

2.6.4.6. Slow and Flowing Movements

The movements performed in the Pilates exercise should be done calmly and harmoniously, but without hesitation. There are no sharp transitions and hard movements in the basic principle of Pilates exercise. The movements are constantly performed in a slow motion in harmony with the breath control (57).

Compliance is the most important factor in Pilates exercise. Slow and fluent movements are the result of this harmony. There is no fast transition in this exercise. Breathing, concentration integrity is the most basic movement control (16).

It should be noted that every principal present in this principle is applied in an auto-controlled manner. Regular and systematic transitions like the wheel of the clock are suitable for the purpose of Pilates exercise and allow to reach the desired result (16).

Figure 2.6. Slow and Flowing Movements (57)

2.6.5. Elements of Pilates Exercise

The general definitions of the basic elements of Pilates exercise in different sources are as follows;

- Stretching – extending the axle / Core control: Many studies have revealed that the transversus abdominis, multifidus, diaphragm and abdominal oblique muscles are the main elements that provide movement in healthy individuals with a history of low back pain (1). Core control, which also means fixing the body center, allows the muscles of healthy individuals to develop (16).

- Effective integrity of the head, neck and shoulder area: It increases the mobility of the head, face, neck and shoulder areas related to the body and reduces excess energy loss. Correct shaping of the upper extremity prevents harmful pressures that cause injuries caused by the shoulder joint and surrounding ligaments. Thanks to the upper body exercises of the Pilates exercise, the muscle laziness in that area is prevented and it allows to take shape (16).
- Spinal patency: It has been observed that the expected result could not be achieved today in studies on increasing the movement between the vertebrae and reducing the difficulties that cause micro and macro trauma of parts with high mobility (16).
- In studies where it is stated that the mobility of the vertebrae can be increased up to a certain point in line with the studies, the forces of micro and macro traumas can be kept up to a certain level, but cannot be reduced (16).
- Correct position and posture: It has been reported that walking facing the ground causes more energy loss than walking facing forward. It draws attention to the importance of strengthening the muscles of the body in terms of correct posture techniques and at the same time performing the movement in the correct position and posture thanks to Pilates. Pilates is an important exercise principle in correcting the posture that gives curvature to the slightly bent spine, which is called hunched posture (16).
- Movement Integrity: If the integrity of the movement is correct to the extent that allows the musculoskeletal system to open, as well as the integrity that includes the digestive, circulatory, respiratory and reproductive systems and the mind, emotions, subconscious, spirit and physical body, if the human body constitutes this integrity with the right movement integrity is of importance (16).

Elements of Pilates exercise can be fixed with principles. In this way, it is possible to achieve the targeted result. As with all exercises, Pilates exercises should be consulted before performing Pilates exercises and should be performed in the presence of experts.

2.6.6. Pilates Movement Elements

The basis of movement principles of Pilates exercise; to develop coordination, balance, flexibility, muscular endurance. Pilates exercises are one of the rare exercises of functional type. The basic principle of the exercise consists of different combinations of movements (5, 16, 58).

The fact that Pilates movements consist of basic principles allows the formation of different combinations of this exercise depending on these foundations.

Pilates exercises consist of more than 500 exercises ranging from beginner to advanced. The work can basically happen in two ways. Pilates mat training or working with Pilates devices. These devices are; Cadillac, Wunda Chair, Reformer, Barrel, Spine Corrector (59).

The five hundred basic movements of Joseph Pilates have been determined from the beginning to the development, and these determined movements are done by focusing on the basic principles. Movements can be performed on the mat, as well as with devices operating in basic logic called Cadillac, Wunda Chair, Reformer, Barrel, Spine Corretor (16).

At this point, the visuals of these devices are given in Figure 2.7, Figure 2.8, Figure 2.9, Figure 2.10, Figure 2.11.

Figure 2.7. Cadillac (59)

Figure 2.8. Wunda Chair (59)

Figure 2.9. Reformer (59)

Figure 2.10. Barrel (59)

Figure 2.11. Spine Corrector (59)

2.6.7. Current Approaches to Pilates Exercise

Pilates exercise is a type of exercise that is still actively used today. Modern Pilates has started to be shaped according to the needs of modern life in accordance with Pilates philosophy and principles. Pilates exercise can be developed by adhering to these principles at all fitness levels. The modern Pilates exercise, which can be used in all rehabilitation exercises, has made it possible to exercise at a higher level with diagonal movements, unlike the traditional Pilates exercise performed in the sagittal plane (16).

Modern Pilates explores how the body responds, based on areas such as anatomy, kinesiology, and physiology. Examining how psychological, emotional and social factors affect exercise and how the mind works is among the priorities of modern Pilates. It should be taken into account that each body type has different needs in exercise methods. The main purpose of modern Pilates is to define the body, to allow breathing to be done consciously and correctly beyond an instinctive movement, to allow the working system of the muscles to feel physically and mentally, and to prevent excessive stress. As in all other exercises, it is shaped according to the person who will do the exercise in modern Pilates. All the needs of the individual are determined, and the weak and strong aspects are determined according to the body type. It can be shaped according to the needs of individuals by adhering to the basic principles of Pilates exercise. In this way, with the changes made, Pilates can be made suitable for people of all ages, those with low fitness levels, such as pregnant women, people who have experienced an injury or performance athletes. Changes according to the person is the primary goal of modern Pilates (60).

The development of modern Pilates affects both fitness Pilates and clinical Pilates. Today's lifestyle and the needs of individuals are quite different from the lifestyle and needs of individuals at the beginning of the 20th century. Developed technology and job opportunities also cause individuals to be more conscious about health (16).

Adhering to the basic principles of Pilates exercises, it is appropriate to develop this exercise innovatively for individuals, in accordance with the purpose of Pilates exercise (16).

Aeropilates, another Pilates exercise that has been developed, has emerged to gently increase flexibility, improve posture and mobility for individuals regardless of age. In this Pilates exercise, it is aimed to develop even muscles that have never been developed. For example, it provides cardiovascular training with a diet determined by experts to improve heart health (61).

Pilates exercises, which are still developing today, continue to be shaped according to living conditions. The systems developed in accordance with the basic principles allow the muscles that tend to become lazy with the developing technology and allow the individual to stay both mentally and physically healthy (16).

2.7. Definition of Physical Fitness

According to the World Health Organization, health is defined as a state of physical, physiological, psychological and mental well-being. Physical fitness is the ability of a person to perform occupational, recreational and daily activities correctly and successfully without fatigue (ACSM, 2014) (62, 63). Physical fitness, which is expressed as 'physical fitness' in the general literature, is expressed as "adjusting to the environment in a positive way" and "working capacity of the person" according to other definitions. According to these definitions, physical fitness is related to the individual's strength, endurance, coordination, quickness and the level of working together of these elements (64).

2.7.1. Physical Fitness Elements

Considering the physical fitness parameters, body composition, cardiorespiratory fitness, muscular fitness and flexibility are the health-related parameters; coordination, balance, agility, power, speed and reaction time are divided into two, forming the performance-related part (63).

2.7.1.1. Balance

Balance; It is a voluntary or involuntary postural adjustment created by combining and interpreting vestibular, proprioceptive and visual data in the central nervous system

against changes in gravity (65). According to another definition, balance is the ability of the body to continue its movements within the support area (66). Balance; It is divided into two as static and dynamic balance in order to maintain its alignment without deterioration and adapt to the center of gravity according to the constant mobility of the support surfaces on which the segments forming the body are located and the effect of external stimuli. Static balance; It is an automatically provided balance, where usually isometric contraction of the muscles is required in order to maintain the fixed position of the parts of the body on a stable support surface and without the need for any external support. Dynamic balance is; It is to maintain and maintain balance on an unstable support surface or in activities where body segments must be mobile, and to correct it in cases where the balance is impaired. Isotonic, isometric and ecenteric contraction of the muscles is required to provide dynamic balance, it is more complex than static balance in terms of maintaining movement (67). In order for balance to be created voluntarily or involuntarily, during rest or activity, the central nervous system, sensory system and musculoskeletal system must work in a coordinated manner (68).

2.7.1.2. Flexibility

Flexibility can be defined as the ability to move the joint (elbow, knee, etc.) or joint rows (spine, etc.) possible (64). If the person's flexibility is low, she/he may have difficulty even doing things such as tying shoes and bending down to pick things up from the ground (69). It is affected by factors such as body type, age, gender and physical activity. In addition, the elasticity of soft tissues and the decrease in physical activity with age also reduce flexibility (70). Flexibility; is constrained by bone structure, ligaments, and other connective tissues (71). If flexibility is limited by soft tissues (muscle, fat, etc.), flexibility can be increased with appropriate stretching methods. Stretches made with shrugging, jumping and sudden strains prevent the desired flexibility from reaching the stretching reflexes. Static stretching activates miotic reflexes, which helps relax the muscles to be stretched. In addition, static stretching does not cause muscle pain as it does not apply sudden stretching to the tissues and is safer (64).

Flexibility ensures proper joint range of motion, prevents injury, improves performance and activity efficiency. Adequate level of flexibility contributes significantly to higher quality, stronger and faster movements specific to the sport branch, to the

improvement of the coordination and performance of the athletes, and to the reduction of the risk of injury (72).

2.7.1.3. Agility

Agility is defined as the ability to move the body easily, quickly, fluently and in a controlled manner and to change direction between two points by working together with speed, strength and neuromuscular coordination (14). Agility; It is a physical skill that enables efficient implementation of acceleration, deceleration and change of direction movements in a short time (73). Agility; It has a speed component, but speed isn't the most important. It is a complex component of physical fitness with multiple components, including speed as well as coordination, balance and the ability to react to environmental changes (74). Agility and quickness are concepts that are confused with each other. Quickness is the ability of muscles and limbs to mobilize joints in the shortest possible time despite the resistance of the body or part of the body to external resistance (73).

2.7.1.4. Aerobic Capacity (Endurance)

Aerobic capacity, also known as cardiopulmonary capacity, cardiorespiratory fitness, or VO2 max, is a measurement of your maximum oxygen consumption during physical activity. This is a reflection of your aerobic power and your body's ability to perform longer under strenuous activity. Aerobic capacity is the ability of the heart and lungs to supply the body with oxygen for exercise. Cardiorespiratory fitness is a good summary measure of the body's ability to perform sustained, rhythmic, dynamic, large muscle group physical activity and exercise (12, 13).

Cardiorespiratory fitness is defined as the ability of the heart, lungs, and circulatory system to effectively supply working muscles with oxygen and nutrients (75). Aerobic endurance is the ability to sustain dynamic and moderate-to-high-intensity activities for extended periods that use large muscle groups (63). In another definition, cardiorespiratory fitness is the ability of the whole organism to resist fatigue in long-term sports exercises and to maintain very high-intensity loads for a long time (73). Cardiorespiratory fitness, also referred to as aerobic fitness, is an indicator of an individual's body's capacity to use oxygen and can best be increased by rhythmic and continuous long-lasting regular aerobic (endurance) exercises such as running, cycling, and swimming (69).

2.8. Swimming

Swimming can be defined as standing in water without sinking. According to another view, swimming is defined as a kind of water sport, the whole of the movements that enable to move on or in the water and to move in one direction. Swimming, one of the oldest sporting activities of mankind, is a pleasure and racing sport that is quite common in almost all parts of the world. Swimming in the sense of sportive competition; It is a competition in which each competitor performs in each of the freestyle, backstroke, butterfly and breaststroke styles or mixed, individually or as a team, without any help other than the strokes and foot movements of the body in pools of international standards (77).

Swimming is one of the rare sports that is performed in water and provides the most perfect physical development. Swimming, in which the gravity feature is reduced to almost zero, allows all the muscles of those who do this sport to work in harmony and harmony. Since it is made against the resistance of water, it increases the body resistance without having a corrosive effect. At the same time, swimming, which is one of the rare sports used in physical therapy, provides the development of body muscles in a symmetrical and balanced way (76).

It is indisputable that every sport that is done consumes oxygen, expands the vessels and strengthens the heartbeat. However, since swimming is performed in a horizontal position, the heart and circulatory system work more comfortably. Therefore, the circulatory system of swimmers is more regular compared to other athletes (76).

According to the results obtained from the general literature reviews, it is accepted that swimming increases the forced vital capacity (FVC) and accordingly the forced expiratory volume in the first second (FEV1) and the maximum voluntary ventilation (MVV) value even after 12-15 weeks of moderate intensity training. is being done. Since the swimmer is in a horizontal position, air also enters the upper part of his lungs. Thus, vital capacity is more developed in swimmers compared to other sports (76).

The aim of this study is to investigate the effect of 8-week swimming exercise on some performance parameters of balance, flexibility, agility and aerobic capacity in young sedentary women.

2.8.1. Benefits of Swimming

1. It improves your stamina and flexibility.
2. It develops your muscles and provides balance. Many professional and amateur athletes do the exercises.
3. It strengthens the heart.
4. It changes your physical appearance.
5. It regulates circulation. It is useful in diseases such as varicose veins.
6. It provides weight control.
7. It reduces stress and tension.
8. It is the recommended type of exercise since it puts less strain on the joints and ligaments in diseases such as joint inflammation.
9. Swimming for 1 hour consumes an average of 500 calories.
10. It gives energy.
11. It treats muscle weakness (76, 77).

3. MATERIAL AND METHOD

3.1. Study Design

This study is a fully experimental study and was carried out as a pretest-posttest control group model. Participants were randomly distributed into groups. This research study is a comparative study comparing two different exercise methods.

3.2. Sample Size and Selection

This study was carried out in the gym of the Fizyoroyal Physical Therapy Clinic. Healthy young female volunteers, aged between 20 and 30, without any medical diagnosis, constitute the sample of this study. It was aimed to reach the sample of the study on a voluntary basis with a handbook prepared by the research coordinator and containing the purpose and method of the study. The total sample size of the study; Using the GPower program, the type 1 error value was calculated as α = 0.05, Power (1-β) = 0.80, the effect size f value was calculated as 0.25 by calculating from the moderate reference article, and the total sample size was calculated as 20 people for the Bidirectional Repeated Measures ANOVA test. However, we chose a sample size of 30 people for the power, reliability and normal distribution of the study.

Analysis:	A priori: Compute required sample size		
Input:	Effect size f	=	0,2526456
	α err prob	=	0,05
	Power (1-β err prob)	=	0,80
	Number of groups	=	1
	Number of measurements	=	5
	Corr among rep measures	=	0,5
	Nonsphericity correction ε	=	1
Output:	Noncentrality parameter λ	=	12,7659598
	Critical F	=	2,4920493
	Numerator df	=	4,0000000
	Denominator df	=	76,0000000
	Total sample size	=	20
	Actual power	=	0,8022638

All participants were screened according to inclusion and exclusion criteria. After the participants were selected, they were explained about the research and asked to sign a consent form. All participants were also given an information form. The 18 out of 50 subjects who wanted to participate in this study reported that they would not be able to continue the exercise program regularly due to intense work pace and lack of time. 2

subjects could not participate in the study because they were clinically diagnosed with lumbar hernia. This caused the study to not be carried out with 50 participants. After selecting participants who met the inclusion and exclusion criteria, they were randomly assigned to their groups. Ten people were determined as the Pilates group, ten people as the swimmer group and ten people as the control group (Figure 3).

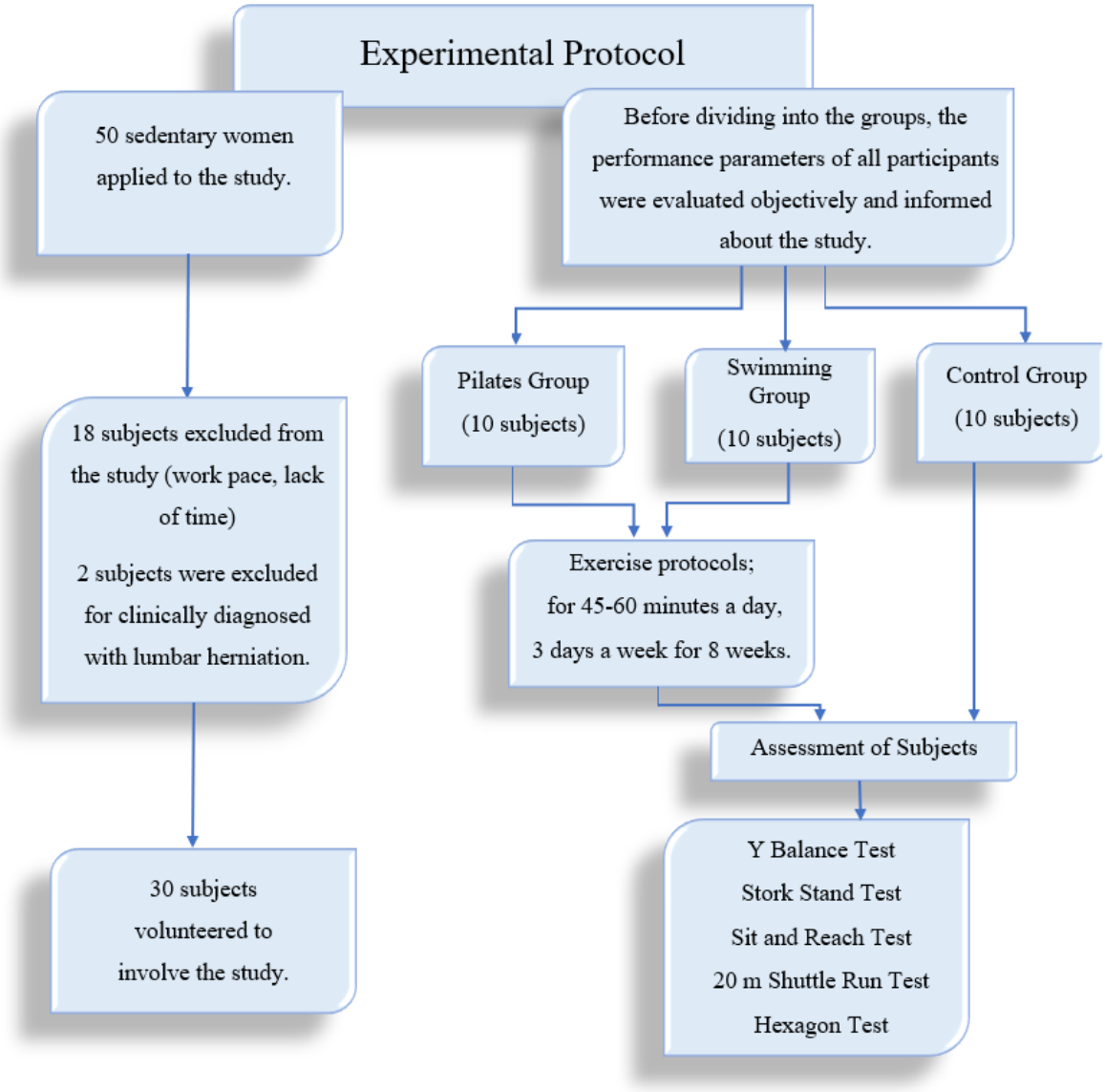

Figure 3. Flow chart of the experimental protocol

3.3. Variables

3.3.1. Dependent Variables

• Balance Performance (Static and Dynamic Balance)
• Flexibility Performance
• Aerobic Capacity Performance
• Agility Performance

3.3.2. Independent Variables

• Clinical Pilates Exercises
• Swimming Exercises
• Recreational regular exercise
• Healthy female individuals

3.4. Participants

3.4.1. Inclusion Criteria

• Individuals were between 20-30 years of age to avoid degenerative changes in the spine and no major difference in aerobic capacity.
• Volunteering for the study.
• Healthy women were included.
• Completing the work.
• She/He has no previous injuries that could interfere with work.
• Not having undergone any surgical operation.
•Those who have not participated in any exercise program in the last 6 months.

3.4.2. Exclusion Criteria

• Those who do not speak Turkish.
• The presence of any medical diagnosis.
• Receiving any other treatment (including medication) that could affect the results of the study.
• Those who have any cardiological, neurological, orthopedic and oncological diseases.
• Those who continue another exercise program.

3.5. Assessments / Primary Outcome Measures

3.5.1. Y Balance Test

Y-Balance Test (YBT) was used in the dynamic balance measurements of the participants. Leg length of each participant; It was measured in centimeters from the anterior superior iliac point to the distal part of the medial malleolus in the bilateral supine position. Anterior (ANT) reach was tested as the distance between the farthest point the participant can reach from the middle finger and the posterolateral (PL) and posteromedial (PM) heel. Participants must be shoeless during the test. Three test trials were conducted in each direction. All reach distances are recorded in centimeters. After the data were obtained, the best reach scores for each direction were normalized according to the leg length values using the formula "(best reach distance/leg length) x 100=%Max". The mean score value (COMP) was found by averaging the normalized ANT, PL, and PM scores (9).

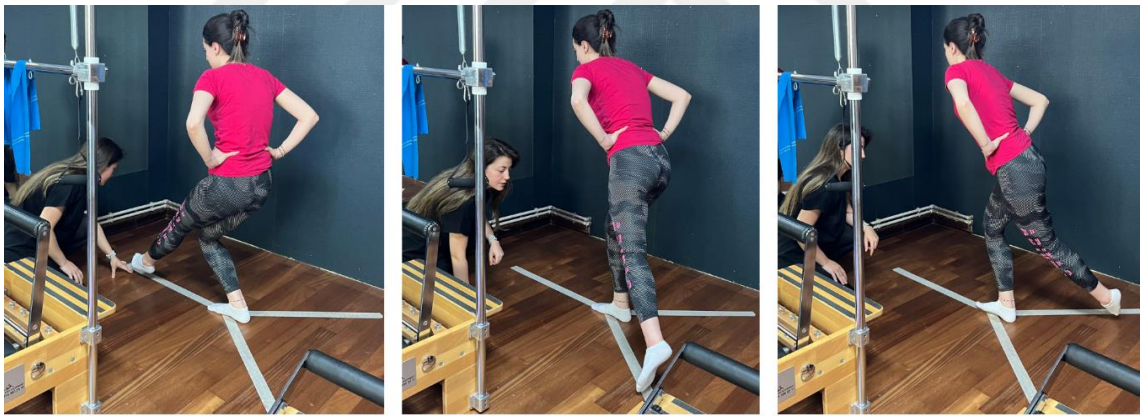

Figure 3.1. Y Balance Test for Right Leg

Figure 3.2. Y Balance Test for Left Leg

3.5.2. Stork Stand Test

Stork Stand Test was used to evaluate static balance performance. Participants stand with opposite feet on the inside of the supporting knee and both hands on the hips. At the command, the participants lift the heels of their feet off the ground and try to maintain their balance for as long as possible. This test is performed on the dominant leg. The test is timed using a stopwatch. The recorded score (time in seconds) is the best of three attempts (10).

Figure 3.3. Stork Stand Test

3.5.3. Sit and Reach Test

The sit-and-reach test was used to measure lumbosacral and hip joint (hamstring) flexibility. During this test, subjects sit on a mat with both feet resting on the test box. They stretch their legs and place their right hand on the left and slide their hands along the measuring board with an extension of 23 cm, stretching the torso as far forward as possible. Each subject performs three trials. The highest value is recorded (11).

Figure 3.4. Sit and Reach Test

3.5.4. The 20m Shuttle Run Test

In this study, 20 m shuttle run test was used to evaluate aerobic fitness levels. The 20m shuttle run test involves a continuous shuttle run between two parallel lines set at exactly 20 m intervals, from signals produced from a properly pre-recorded CD to recorded beeps. The initial speed is set at 8.5 km/h and is increased by 0.5 km/h per minute. Each phase of the test consists of several shuttle runs, and subjects are instructed to keep up with the signal as much as possible. For each participant, the test is terminated when the participant is no longer able to maintain the speed cadence for more than two consecutive beeps. The number of sit-ups completed for each participant is recorded as an index of their aerobic fitness levels (13).

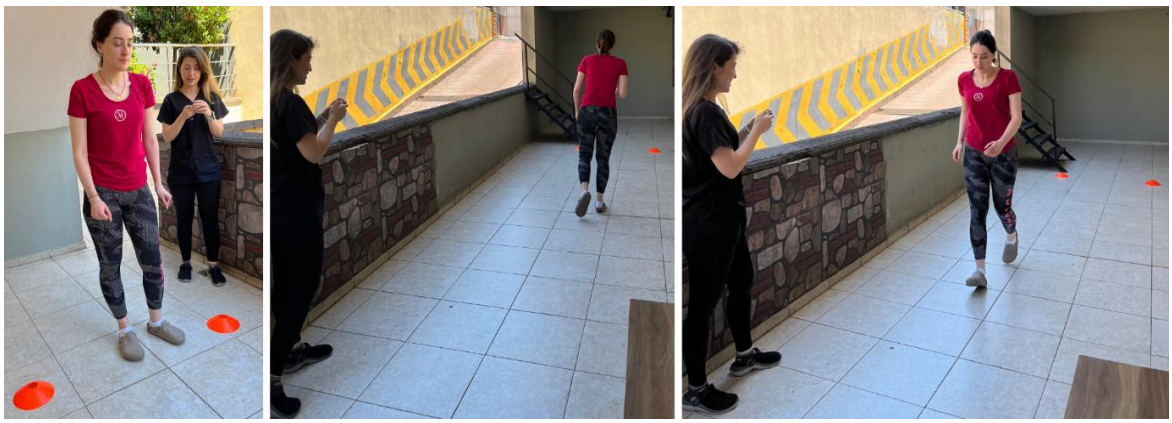

Figure 3.5. 20m Shuttle Run Test

3.5.5. Hexagon Test

Agility was measured using the well-known hexagonal agility test with excellent test-retest reliability. The hexagon with 24inch sides and 120° angles is marked using tape on the floor with a 12inch strip of tape in the middle to mark the starting position. At the start of the test, the participant stands barefoot on the tape strip in the middle of the hexagon facing the front line. With the "Start" command, they jump ahead of the line and then return over the same line to the middle of the hexagon. While maintaining a forward-facing position with feet together, the participant jumps out of the hexagon and back into it. Each participant must complete 3 full laps (trials) clockwise. A stopwatch is used to record the time of each revolution. If the participant does not completely skip each line that borders the hexagon, the data is not saved and they must repeat the experiment. The average completion times of 3 clockwise trials will be used for analysis. A shorter completion time indicates superior agility (15).

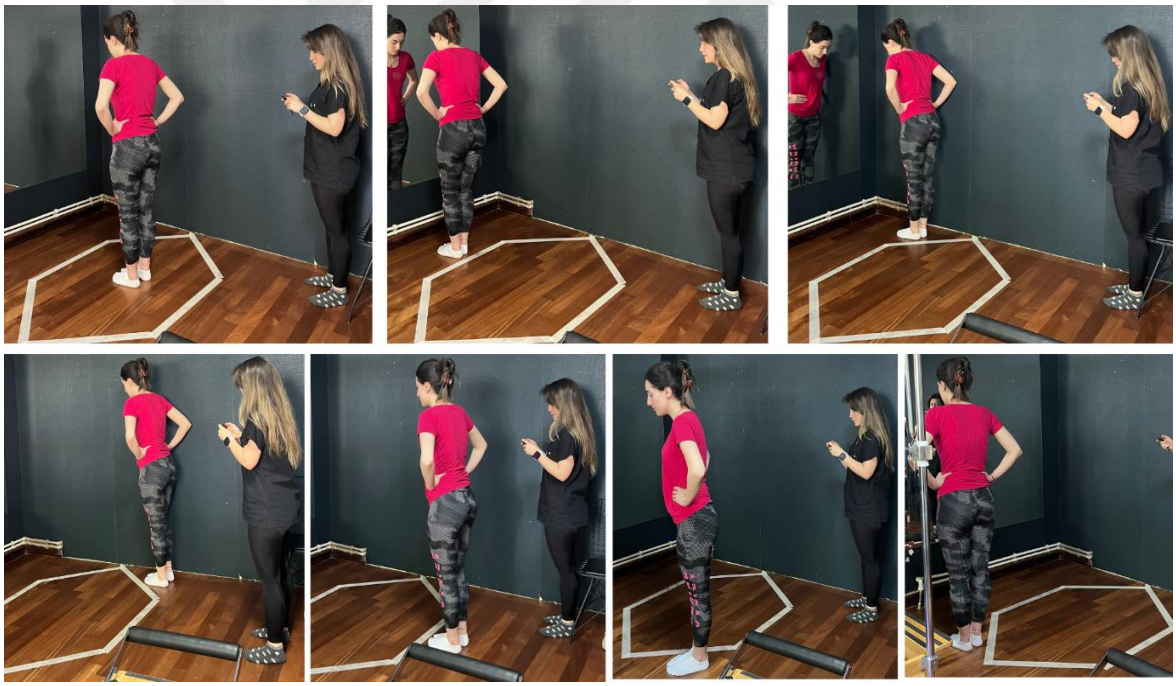

Figure 3.6. Hexagon Test

3.6. Interventions / Exercise Methods

3.6.1. Clinical Pilates

Individuals in the Pilates group were given Clinical Pilates exercises, 3 times a week, for 8 weeks in the Fizyoroyal Physical Therapy Clinic, accompanied by a physiotherapist. The exercises were done in the form of group training. Each exercise

session is planned as 45-60 minutes. The Pilates exercise program consists of warm-ups, exercises on the mat, and cool-down periods.

All subjects were taught the key elements of Pilates for 1 session before Pilates exercise training. These key elements are breathing, focusing, rib cage placement, shoulder placement, head and neck placement. After providing spinal stability and completing the 5 key elements of Pilates exercises, exercises were created within the framework of Pilates principles.

Before starting the exercise training, a device called "Stabilizer Pressure Biofeedback" was used to teach the subjects the correct functioning of deep neck flexors, transversus abdominus and lumbopelvic posture. For deep neck flexors training, the subject was placed in the supine position in the hooked position. A towel was placed under the occiput. The stabilizer was inflated to 20 mmHg and placed under the neck. The subject was asked to extend the head slightly backwards and increase the pressure to 30 mmHg in a way to create pressure at increasing values such as 22, 24 mmHg on the gauge on the stabilizer.

For transversus abdominis training, the subject was placed in the prone position. The stabilizer was inflated to 70 mmHg and placed under the abdomen. The subject was asked to reduce the pressure by 4.6 mmHg by contracting the transversus abdominis muscle.

For the lumbopelvic posture, the subject was placed supine in the hooked position. The stabilizer was inflated to 40 mmHg and placed in the lumbar region. The subject was asked to keep the indicator on the stabilizer constant at 40 mmHg by co-contraction of the transversus abdominis and multifidus.

Figure 3.7. Stabilizer Pressure Biofeedback

During the Pilates exercise training, the accuracy of the key elements was tested with the help of stabilizer at certain intervals in all cases from time to time. During the training, subjects were asked to provide key elements and protect them during movements. During Pilates exercise training, all movements were checked by the physiotherapist and necessary corrections were made. The exercises were done with 8-10 repetitions. The degree of difficulty was increased when subjects performed the exercises properly for 10 repetitions (approximately every 2 weeks) while preserving key elements. The exercises start from the closed kinetic form and go towards the open kinetic form. After ensuring spinal smoothness in each movement, the next stage was started and progressed to the 5th level (3). The subjects were carried out on the treadmill for 10 minutes for the Pilates warm-up period and 5 minutes for the cooling period. The movements made in the training program to be applied are shown in Table 3.1. The specified movements were applied on the mat varying and modified according to the individual (5).

Table 3.1. Movements Made in the Implemented Pilates Training Program

Exercises	The number of repetitions (1-4 Weeks)	The number of repetitions (4-8 Weeks)	Rest Between Movements
HUNDRED	10 reps	10-12 reps	1 min
ROLL UP	6-8 reps	8-10 reps	1 min
LEG CIRCLES	6-8 reps	8-10 reps	1 min
ROLLING LIKE A BALL	10 reps	10-12 reps	1 min
SINGLE LEG STRETCH	10-12 reps	12-15 reps	1 min
DOUBLE LEG STRETCH	6-8 reps	8-10 reps	1 min
SINGLE STRAIGHT LEG STRETCH	10-12 reps	12-15 reps	1 min
DOUBLE STRAIGHT LEG STRETCH	6-8 reps	8-10 reps	1 min
CRISS CROSS	8-10 reps	12-15 reps	1 min
SPINE STRETCH	6-8 reps	8-10 reps	1 min
SAW	8-10 reps	10-12 reps	1 min
SWAN	6-8 reps	8-10 reps	1 min
SINGLE LEG KICK	8-10 reps	10-12 reps	1 min
DUBLE LEG KICK	8-10 reps	10-12 reps	1 min
SIDE KICK	6-8 reps	8-10 reps	1 min
SEAL	8-10 reps	10-12 reps	1 min
PUSH UP	8-10 reps	10-12 reps	1 min

Figure 3.8. Hundred

Figure 3.9. Roll Up

Figure 3.10. Leg Circles

Figure 3.11. Rolling Like a Ball

Figure 3.12. Single Leg Stretch

Figure 3.13. Double Leg Stretch

Figure 3.14. Single Straight Leg Stretch

Figure 3.15. Double Straight Leg Stretch

Figure 3.16. Criss Cross

Figure 3.17. Spine Stretch

Figure 3.18. Saw

Figure 3.19. Swan

Figure 3.20. Single Leg Kick

Figure 3.21. Double Leg Kick

Figure 3.22. Side Kick

Figure 3.23. Seal

Figure 3.24. Push Up

3.6.2. Swimming

The individuals in the swimming group were given swimming exercises in the private swimming pool of the Fizyoroyal Physical Therapy Clinic, 3 times a week, for 8 weeks, accompanied by a physiotherapist. The exercises were done in the form of group training. Each exercise session is planned for a total of 45-60 minutes, with all swimming styles 10 minutes and 5 minutes rest periods between each set. Swimming exercise program; It is set in 4 styles as freestyle, butterfly style, backstroke style and breaststroke style. The control group was informed that they would remain sedentary for 8 weeks, and at the end of this period, they could participate in any exercise program if they wished.

Figure 3.25. Swimming Styles

3.7. Data Analysis

All analyzes were performed by the SPSS (Statistical Package for Social Sciences) statistical program with a 95% confidence interval and a significance level of 0.05. While interpreting the results, 0.05 was taken as the significance level; If $p<0.05$, there is a significant relationship, and if $p>0.05$, there is no significant relationship. Frequency distributions, arithmetic means and standard deviations of the obtained data are presented as descriptive statistics (16).

In order to test the normality, the skewness and kurtosis values were examined, the extreme values were checked and the Shapiro-Wilk Test was performed. The p values were greater than 0.05, it indicated that the data came from a normally distributed population. Although the group would be normally distributed, non-parametric tests, Kruskal Wallis analysis of variance, were used for analysis due to the small group sizes and outliers found in the data. Mann-Whitney U test was used for analysis between groups. Wilcoxon Signed Ranks Test was used for pre-test / post-test difference analysis in group analyses (3).

The Kruskal Wallis Test does not include multiple comparison options. Because there was a significant difference in the Kruskal Wallis test result between more than two groups, the possible pairings of all groups were compared with the Mann-Whitney U test. The difference between the pre- and post-evaluations was calculated with the Wilcoxon Signed Rank test (4).

4. RESULTS

30 female subjects (mean age 25,53±3,37 years, mean height 162,33±2,60 cm, and mean weight 61,80±5,80 kg) were participated in this study.

The physical features (age, weight and height) of Pilates Group (PG), Swimming Group (SG) and Control Group (CG) are presented in Table 4.1. There were no statistically significant differences in age and height, weight in three groups.

When the groups were compared in terms of demographic characteristics, it was determined that there was no significant difference between the groups in terms of age, height and weight of the cases (p>0,05). The distribution of demographic characteristics of the cases, including age, height, and weight, by groups is shown in Table 4.1.

Table 4.1. Physical Features of Participants

Variables	**PG** mean±SD	**SG** mean±SD	**CG** mean±SD	**p value**
Age(year)	25,30±3,52	25,80±3,58	25,50±3,02	0,923
Weight(kg)	61,80±5,80	62,46±4,98	60,77±6,81	0,866
Height(cm)	162,70±2,75	163,90±2,55	165,40±2,50	0,787

Data expressed as mean ± standard deviation. cm: centimeter, kg: kilogram. PG: Pilates Group, SG: Swimming Group.

A Mann-Whitney U test was used to compare of variables between participants of PG, SG and CG before interventions (Table 4.2). The data underlined that all variables had not statistically significant differences in both groups *(p>0,05).*

When the physical fitness data of the groups were compared before the exercise; It was determined that there was no significant difference between the groups in static and dynamic balance, flexibility, aerobic capacity and agility values (p>0,05). The data obtained are shown in Table 4.2.

Table 4.2. Comparison of Variables between three groups before interventions

Variables	Scales		PG mean±SD	SG mean±SD	CG mean±SD	p value
Static Balance Measurement	**Stork Stand Test**	**Right**	18,44±4,40	18,40±5,44	18,04±4,82	0,971
		Left	20,16±5,84	17,95±4,29	15,92±3,97	0,152
Dynamic Balance Measurement	**Y-Balance Test**	**Right**	65,80±5,28	67,10±4,86	67,20±4,66	0,526
		Left	68,80±5,47	67,10±4,88	65,50±3,95	0,433
Flexibility Measurement	**Sit and Reach Test**		19,20±2,48	20,70±4,64	20,80±2,65	0,538
Aerobic Capacity Measurement	**20 m Shuttle Run Test**	**Level**	4,00±0,81	4,30±1,05	4,60±1,71	0,535
		Shuttle	3,30±1,56	5,00±2,35	4,60±2,22	0,216
Agility Measurement	**Hexagon Test**		28,98±3,95	30,77±3,53	30,07±3,51	0,624

Data expressed as mean ± standard deviation. PG: Pilates Group, SG: Swimming Group, CG: Control Group.

Wilcoxon signed rank test was used to analyze for the differences in regard to pre and post-test mean scores of static balance measurements. Comparing pre and post measurement findings of the Stork Stand Test values showed that Pilates group had statistically significant increase in Stork Stand Test ($p:0.00$; $p<0.05$). However, when we compare the results of the control and swimming groups, no significant differences revealed in the Stork Stand Test ($p:0.72$, $p: 0.63$; $p:0.20$, $p:0.22$; $p>0.05$). It means that participants in Pilates group had improvement in results of Stork Stand Test during final measurements compared to SG and CG (Table 4.3).

Table 4.3. Intragroup Comparison of Pre and Post Intervention Findings for Static Balance Measurement

Scales		PG mean±SD	p & t values	SG mean±SD	p & t values	CG mean±SD	p & t values
Right Stork Stand Test	**Pre**	18,44±4,40	**p: 0,007 t: -2,80**	18,40±5,44	p: 0,204 t: -1,80	18,04±4,82	p:0,721 t: -0,35
	Post	32,15±4,57		22,01±4,26		17,01±4,78	
Left Stork Stand Test	**Pre**	20,16±5,84	**p: 0,002 t: -2,80**	17,95±4,29	p: 0,223 t: -1,81	15,92±3,97	p:0,631 t: -1,93
	Post	35,47±5,35		20,81±4,44		13,19±3,96	

Wilcoxon signed rank test. Data expressed as mean ± standard deviation. PG: Pilates Group, SG: Swimming Group, CG: Control Group.

Comparing pre and post measurement findings of Y-Balance Test values were shown that Pilates group had statistically significant increase in Y-Balance Test (p:0.00; $p<0.05$). However, when we compare the results of the control and swimming groups, no significant differences revealed in the Y-Balance Test (p:0.21, p: 0.58; p:0.32, p:0.25; $p>0.05$). The results of PG and SG groups were better than the control group in Y-Balance Test. Besides, the control group had a slight decrease after the 8 weeks period (Table 4.4).

Table 4.4. Intragroup Comparison of Pre and Post Intervention Findings for Dynamic Balance Measurement

Scales		PG mean±SD	p & t values	SG mean±SD	p & t values	CG mean±SD	p & t values
Right Y-Balance Test	**Pre**	65,80±5,28	**p: 0,003 t: -2,81**	67,10±4,86	p: 0,325 t: -1,83	67,20±4,66	p:0,214 t:-1,24
	Post	84,10±3,14		68,90±4,43		65,00±5,27	
Left Y-Balance Test	**Pre**	68,80±5,47	**p: 0,001 t: -2,80**	67,10±4,88	p: 0,257 t: -1,83	65,50±3,95	p:0,583 t:-1,89
	Post	87,00±2,21		68,10±4,48		63,40±4,50	

Wilcoxon signed rank test. Data expressed as mean ± standard deviation. PG: Pilates Group, SG: Swimming Group, CG: Control Group.

Comparing pre and post measurement findings of Sit and Reach Test values showed that Pilates group had statistically significant increase in Sit and Reach Test (p:0.00; p<0.05). However, the control and swimming groups score changes were not statistically significant differences in Sit and Reach Test (p:0.58, p: 0.10; p>0.05). It means that participants in PG had improvement in results of Sit and Reach Test when compared with the SG and CG. However, the results of SG group were higher than the control group in flexibility (Table 4.5).

Table 4.5. Intragroup Comparison of Pre and Post Intervention Findings for Flexibility Measurement

Scales		**PG** mean±SD	**p & t values**	**SG** mean±SD	**p & t values**	**CG** mean±SD	**p & t values**
Sit and Reach Test	**Pre**	19,20±2,48	**p: 0,000 t: -2,87**	20,70±4,64	p: 0,102 t: -1,82	20,80±2,65	p:0,581 t: -1,73
	Post	30,60±3,06		22,80±3,61		20,10±2,46	

Wilcoxon signed rank test. Data expressed as mean ± standard deviation. PG: Pilates Group, SG: Swimming Group, CG: Control Group.

Comparing pre and post measurement findings of the 20 m Shuttle Run Test values showed that swimming group had statistically significant increase in the 20 m Shuttle Run Test (p:0.00; p<0.05). However, Pilates and control groups did not show any differences in the 20 m Shuttle Run Test (p: 0.11, p: 0.09; p:0.15; p>0.05). Compared to the PG and CG, participants in swimming group had better improvement in results of the 20 m Shuttle Run Test during final measurements (Table 4.6).

Table 4.6. Intragroup Comparison of Pre and Post Intervention Findings for Aerobic Capacity Measurement

Scales			PG mean±SD	p & t values	SG mean±SD	p & t values	CG mean±SD	p & t values
The 20 m Shuttle Run Test	Level	Pre	4,00±0,81	p: 0,113 t: -1,97	4,30±1,05	**p: 0,001 t: -2,69**	4,60±1,71	p: 0,153 t: -1,41
		Post	4,90±0,63		8,20±2,04		4,40±1,50	
	Shuttle	Pre	3,30±1,56	p: 0,092 t: -1,45	5,00±2,35	**p:0,000 t: -2,35**	4,40±2,22	p: 0,144 t: -1,21
		Post	4,30±1,56		6,60±1,50		4,10±2,22	

Wilcoxon signed rank test. Data expressed as mean ± standard deviation. PG: Pilates Group, SG: Swimming Group, CG: Control Group.

Comparing pre and post measurement findings of the Hexagon Test values revealed that swimming group had statistically significant decrease in Hexagon Test (p:0.00; p<0.05). However, Pilates and control groups had not statistically significant differences in Hexagon Test (p: 0.23, p:0.19; p>0.05). It means that participants in swimming group had improvement in results of Hexagon Test during final measurements compared to PG and CG (Table 4.7).

Table 4.7. Intragroup Comparison of Pre and Post Intervention Findings for Agility Measurement

Scales		PG mean±SD	p & t values	SG mean±SD	p & t values	CG mean±SD	p & t values
Hexagon Test	Pre	29,98±3,95	p: 0,237 t: -1,70	30,77±3,53	**p: 0,000 t: -2,80**	30,07±3,51	p: 0,196 t: -1,68
	Post	27,61±2,18		14,46±1,35		29,82±3,10	

Wilcoxon signed rank test. Data expressed as mean ± standard deviation. PG: Pilates Group, SG: Swimming Group, CG: Control Group.

The Kruskal Wallis-H Test and Mann Whitney-U Test were executed to analyze the difference between each group across the pre and post intervention measurements on flexibility measurement, static and dynamic balance measurements, agility and aerobic capacity measurements. The results showed that the difference of Sit and Reach Test scores was increased in PG more than SG and CG ($p:0.00$; $p<0.05$). The results showed a statistically significant improvement for flexibility measurement means of volunteers during pre and post measurements in PG compared to SG and CG ($p:0.00$; $p<0.05$). A statistically significant improvement for Sit and Reach Test was observed in PG during post measurement ($p:0.00$; $p<0.05$) when compared with both CG and SG. The results revealed that the improvement of the Hexagon Test scores were higher in SG more than PG and CG ($p:0.00$; $p<0.05$). For agility measurement scores, SG had higher values in pre and post measurements ($p:0.00$). A statistically significant improvement for Hexagon Test was observed in SG during post measurement compared to PG and CG ($p:0.00$; $p<0.05$). According to the intergroup comparison of the Stork Stand Test and Y-Balance Test scores PG had higher means than SG and CG ($p:0.00$; $p<0.05$). The results showed that there were a statistically significant improvements for static and dynamic balance measurement means of volunteers during pre and post measurements in PG compared to SG and CG ($p:0.00$; $p<0.05$). A statistically significant improvement in Stork Stand Test and Y-Balance Test was observed in PG during post measurement ($p:0.00$; $p<0.05$). The results showed that the difference of the 20 m Shuttle Run Test scores was increased in SG more than PG and CG ($p:0.00$; $p<0.05$). The results showed that there were a statistically significant improvements in aerobic capacity measurement means of volunteers during pre and post measurements in SG compared to PG and CG ($p:0.00$; $p<0.05$). A statistically significant improvement for the 20 m Shuttle Run Test was observed in SG during post measurement ($p:0.00$; $p<0.05$). However, the control group had no statistically significant improvements in all variables compared to other groups ($p:0.00$; $p<0.05$) (Table 4.8).

Table 4.8. Comparison of difference between Pre and Post Findings of Static Balance Measurement, Dynamic Balance Measurement, Flexibility Measurement, Aerobic Capacity Measurement and Agility Measurement in Intergroup Variables

Variables	Scales	PG mean±SD	SG mean±SD	CG mean±SD	p value
Flexibility Measurement *(Meter) (cm)*	**Δ Sit and Reach Test**	**11,40±0,58**	2,10±1,03	-0,70±0,19	**0,000**
Agility Measurement *(Stopwatch) (second)*	**Δ Hexagon Test**	-2,37±1,77	**-16,31±2,18**	-0,25±0,41	**0,000**
Static Balance Measurement *(Stopwatch) (second)*	**Δ Right Stork Stand Test**	**13,71±017**	3,61±1,18	-1,03±0,04	**0,000**
	Δ Left Stork Stand Test	**15,31±0,49**	2,86±0,15	-2,73±0,01	**0,000**
Dynamic Balance Measurement *(Meter) (cm)*	**Δ Right Y-Balance Test**	**18,30±2,14**	0,80±0,43	-2,20±0,61	**0,000**
	Δ Left Y-Balance Test	**18,20±3,26**	1,00±0,40	-2,10±0,55	**0,000**
Aerobic Capacity Measurement *(Stopwatch)*	**Δ 20 m Shuttle Run Test (Level)**	0,90±0,18	**3,90±0,99**	-0,20±0,21	**0,006**
	Δ 20 m Shuttle Run Test (Shuttle)	1,00±0,01	**1,60±0,85**	-0,30±0,01	**0,004**

Data expressed as mean ± standard deviation. PG: Pilates Group, SG: Swimming Group, CG: Control Group. Δ: Post values minus pre values.

5. DISCUSSION

In the literature, there is no study investigating the effect of swimming exercise on physical fitness parameters in healthy adults (108). There are very few and limited studies on the effects of Pilates exercises to the physical fitness parameters in healthy adults (109). At the same time, there is no study comparing Pilates and swimming exercises. Therefore, we planned this study to meet the deficiency in the literature and to compare the effects of two exercise modalities on physical fitness parameters. In this study, flexibility, balance, agility and aerobic capacity parameters of the participants in the Pilates and swimming exercise group were assessed before and after the exercise program.

The results of the present study revealed that, Pilates exercise is more effective on balance and flexibility parameters than swimming and control groups. Besides, swimming exercise is found to be more effective on aerobic endurance and agility parameters than Pilates and control groups. Therefore, Pilates exercise program could not be sufficient to increase all physical performance parameters for sedentary women.

5.1. Balance

In the study of Altıntaç et al., the people participating in the floor movements and reformer groups showed flexibility (for the right and left legs), balance values, maximal strength in the leg and chest muscles, endurance of the leg, chest and abdominal muscles, distance covered for aerobic capacity and maximum VO2 increase was observed. In addition, it was shown that there was a very significant increase in balance scores in two groups who performed Pilates floor exercises and applied the reformer program (1). According to Anderson and Spector, Pilates promotes the importance of proprioceptive stimulation for motor learning development using powerhouse exercises, and the training standard promotes repetition of the correct movements to provide better motor performance and reduce the risk of injury. At the same time, better motor performance means better balance (81). Twenty-seven individuals participated in a study investigating the effect of Pilates on personal autonomy, static balance and quality of life in the elderly. Static balance was assessed with the Tinetti test. A statistically significant increase was observed in the static balance of the individuals after 8 weeks of training, 2 days a week (82). In the study of Johnson et al., the effect of Pilates on dynamic balance in healthy adults was investigated. A total of 34 individuals, 17 in the Pilates group and 17 in the

control group, were included in the study. Dynamic balance was assessed with the functional reach test. After 5 weeks of Pilates training, it was observed that the balance of individuals increased statistically significantly. The power house stability of the individuals who participated in the 5-week Pilates training improved, and with the increase in their kinesthetic awareness, they understood how to reduce wrong walking patterns and improved motor control (83).

In this study, Stork-stand test and Y-Balance test were used to assess static and dynamic balance. Consistent with the literature, a statistically significant increase in balance was observed after 8 weeks of Pilates exercises compared to SG and CG. When the measurements for the stork-stand test of the cases were evaluated, it was seen that the balance progressed to high level after the Pilates exercises program.

Deep trunk muscle training is one of the main purposes of Pilates exercises. Pilates exercises coordinate isometric, concentric, cocontraction and eccentric muscle synergies and, therefore, it provides static and dynamic stabilization in all plans of movement (84). In this way, it provides pelvic and lumbar stability and increases balance in parallel with this effect. As a result of this study, the increase in balance in PG may be due to these features of pilates, which has been proven in the above studies. In short, Pilates exercise was found to be effective to improve balance in sedentary women.

In addition, swimming exercises have a low positive effect on balance compared to CG, due to higher means value of SG. However, there is no statistically significant difference on balance in SG, in this study.

5.2. Flexibility

A study led by Michele Olson, Ph. D. was conducted. This research was supported by the American College of Sports Medicine (ACSM) Health & Fitness Summit & Festival to gain some health benefits and learn about Pilates technique. In their study, it was observed that Pilates exercise performed only once a week was effective in flexibility development limited to body composition (54, 116). The study by Baştuğ et al. (2014) aimed to examine the effects of Pilates practice on body composition and flexibility levels of women. Sixty-two female individuals were included in the study. It was determined that there was a significant increase in flexibility measurements at the end of the Pilates practice of the women participating in the study (87). In a study, Kartal investigated the

effect of an eight-week physical exercise program on the physical fitness parameters of sedentary male office workers over the age of 35. They evaluated flexibility with the sit-and-reach test, and as a result of their research, they determined a statistically significant increase in the test score averages after exercise applications (100). Yargıcı compared the effects of different exercise methods (yoga and aerobic exercises) on physical fitness parameters in women and observed a statistically significant increase in the sit and reach flexibility test and decrease hip abduction test measurements in Yoga group compared to aerobic group (101). Studies have shown that the effect of exercises on hamstring muscle flexibility will be more effective if stretching is performed for 30-60 seconds (93, 94). In Pilates exercises, stretching is performed dynamically and continues for 2-3 seconds. The dynamic movement is repeated 4-8 times in each set. Although Pilates is not a ballistic exercise, its mechanism of action on hamstring flexibility is not understood. In a study of middle-aged active men and women, a statistically significant increase in hamstring flexibility was observed after 12 weeks of Pilates exercises (89). A Pilates group of 9 people and a control group of 13 people were included in a study conducted on adults. Sit-reach test and shoulder flexion test were used to evaluate the effect of Pilates exercises on flexibility. A statistically significant increase was observed in the sit-reach test and shoulder flexion test after Pilates exercises (95). Segal et al. investigated the effect of Pilates training on flexibility and body composition. Trunk flexion and hamstring length were used as flexibility assessments. A statistically significant increase was observed in flexibility measurements after Pilates training, and this effect continued until the 6th month (96). In a study by Altıntaç et al., it was shown that there was a very significant increase in the flexibility measurements of the right and left legs in the two groups who performed Pilates floor exercises and applied the reformer program (1). Otto et al. (2004) mention that Pilates reformer exercises have positive effects on flexibility; After the applied training program, it was stated that the improvement level in the sit-reach test scores of the Pilates group was higher than the sit-reach test scores of the resistance training group (88). In a study by Kloubec in 2010, 50 participants performed 60-minute exercises twice a week for 12 weeks, and as a result of this study, they stated that performed Pilates exercises significantly increased hamstring flexibility and upper body muscle endurance (89). According to an article published in the American College of Sports Medicine in 2005, Pilates is a useful exercise for improving flexibility, muscular fitness and muscular endurance, especially for intermediate and senior practitioners (54).

According to a study by Emül, one group was applied only swimming and the other group had swimming and physical training. Flexibility was assessed in children. As a result of the evaluation; It was observed that there was no significant difference in the pretest and posttest results of the flexibility score in the swimming group (91). Wang et al., in their study on the effect of water exercise on flexibility, strength and aerobic physical fitness in individuals with hip and knee osteoarthritis, reported that 6-week work was statistically significant on aerobic physical fitness, strength, hip and knee flexibility (103). Yanardag, in their study examining the effects of exercise training in water and on floor in autistic children, showed that flexibility improved in the sit-reach flexibility test. When the measurements before and after the training were compared in both groups, the difference was determined to be statistically significant. In the sit-reach test, the flexibility value after training was not significant between the groups. In both groups, training was effective in improving flexibility at similar rates (104). Yılmaz et al., before the in-water exercise training, the sit-reach flexibility value was measured as -5 cm and after the training as 0 cm (105). In the study of Çolak et al., a statistically significant difference was obtained in the flexibility values of the subjects in the water and aerobic exercise groups before and after the exercise. The results show similarity when compared with the literature (2). In a study by Çolakoğlu in 2003, when comparing in-water exercises and aerobic exercises, sedentary middle-aged obese women were applied aerobic exercise for 30-45 minutes, 3 days a week for 8 weeks. At the end of the study, a significant increase in flexibility values was determined (90). In a study conducted by Uçar in 2019, they determined that regular swimming training consisting of land and water exercises increased swimming performance in children by showing significant differences in flexibility, vertical jump, and shuttle run performance (92).

The literature researches have shown that Pilates training leads to a higher increase in trunk lateral flexion, quadriceps and hip flexion flexibility and that the flexibility increase in these muscles can be achieved in an average of 8-12 weeks training period. In this study, in accordance with the literature, the sit-reach flexibility test was used to assess flexibility. A statistically significant increase was observed in the flexibility test results after Pilates training compared to SG and CG. Pilates exercises directly stretch the spine in each exercise (3). Pilates exercises may increase flexibility, because they provide stretching in the training and dynamic stretching performed with body smoothness which is the result of increased awareness.

As in the above study of Emül, in the present study, swimming exercise was not found to be effective to improve flexibility in sedentary women. Generally, soft tissues such as muscles, tendons, and ligaments are the limiters of flexibility (115). Swimming exercises may not increase flexibility because they do not stretch these soft tissues. However, it has been found to increase flexibility in most publications researched (114). This may be due to its effect on ROM along with neural control.

5.3. Aerobic Capacity (Endurance)

Gildenhuys et al. in 2013 conducted a study to determine the effects of Pilates training on VO2max in elderly women. Fifty inactive, apparently healthy females aged 60 and older were randomly assigned to either a control (CON) (n = 25) or a Pilates training (PIL) (n = 25) group. The subjects in the PIL group participated in an eight-week progressive mat Pilates training program, three times weekly. Their results obtained from the present study indicate that eight-weeks of Pilates training did not significantly improve VO2max (113). When the changes in the aerobic capacity of sedentary women participating in a study by Avşar et al. were investigated, it was determined that the exhaustion heart rate of the participants decreased, the running times were prolonged, and a significant decrease occurred in the initial heart rate in the final measurement conconi test results compared to the first measurements. According to these findings, it was concluded that participation in Pilates exercise positively affects the aerobic performance of sedentary women (5). Eyigör et al. investigated the effect of Pilates exercises on functional capacity, flexibility, fatigue, depression and quality of life in women with breast cancer. 52 people, aged between 18-75, 27 in the control group and 25 in the Pilates group, were included in the study. The effect on functional capacity was evaluated using the 6-minute walk test. When compared with the control group, it was observed that there was a statistically significant increase in walking distance after training in the Pilates group (98). Wang et al., in their study on the effect of water exercise on flexibility, strength and aerobic physical fitness in individuals with hip and knee osteoarthritis, reported that 6-week work was statistically significant on aerobic physical fitness, strength, hip and knee flexibility (103). According to a study by Emül, one group was applied only swimming and the other group had swimming and physical training. 10 m speed (acceleration), 30 m speed, vertical jump, flexibility, quickness, overhead ball throwing, standing long jump tests were assessed in children. As a result of the evaluation; It was observed that there was a significant difference in the pretest and posttest results

of the 10 m sprint (acceleration), 30 m sprint, vertical jump, quickness, overhead ball throwing, standing long jump test, except for the flexibility score in the swimming group (91). In a study conducted by Uçar in 2019, they determined that regular swimming training consisting of land and water exercises increased swimming performance in children by showing significant differences in flexibility, vertical jump, and shuttle run performance (92). In a study investigating the effect of aerobic exercise on physical fitness in postmenopausal women, the 6-minute walking test was used to evaluate cardiovascular fitness, and statistically significant differences were observed in walking distance and maximum VO_2 values after exercise training (97).

In this study, the 20 m shuttle run test was used to assess cardiovascular endurance. After Pilates training, there was no statistically significant difference in the 20 m shuttle run test running times and the number of shuttles. As in the above study of Gildenhuys et al., Pilates exercises are not effective to improve cardiovascular fitness (aerobic capacity), in this study. The result of the other studies, contrary to this study, Pilates exercises were found to be effective on aerobic capacity. However, according to an article published in the American College of Sports Medicine in 2005, Pilates may have limited potential, particularly for increasing cardiovascular fitness and reducing body weight (54).

As in the above studies, after a 20 m shuttle run test in the swimming group, a statistically significant difference was observed in running times and number of shuttles compared to PG and CG. In this study, swimming exercises have a superiority on running times and the number of shuttles (aerobic capacity endurance) in all age groups compared to PG and CG. Swimming increases aerobic endurance, due to the fact that it is an aerobic exercise. However, it should not be forgotten that Pilates exercises should be accompanied by aerobic exercise when it is desired to achieve an effect on cardiovascular endurance.

5.4. Agility

According to a study by Emül, one group had received only swimming and the other group had swimming and physical training. 10 m speed (acceleration), 30 m speed, vertical jump, quickness, overhead ball throwing, standing long jump tests were assessed in children. As a result of the evaluation; It was observed that there was a significant difference in the pretest and posttest results of the 10 m sprint (acceleration), 30 m sprint,

vertical jump, quickness, overhead ball throwing, standing long jump test in the swimming group (91). Gildenhuys et al. in 2013 conducted a study to determine the effects of Pilates training on agility in elderly women. The subjects in the Pilates training group participated in an eight-week progressive mat Pilates training program, three times weekly. Their results obtained from the present study indicate that eight-weeks of Pilates training significantly improved agility as measure by the eight-foot up-and-go test (113).

In this study, swimming exercises have a superiority on agility in all age groups compared to PG and CG. As in the above study of Emül, swimming exercises are effective to improve agility, in this study. Swimming may increase agility, because it improves the speed, power and strength components with change of direction. The result of Gildenhuys study, contrary to this study, Pilates exercises were found to be effective on agility.

5.5. Superiority

The superiority of this study; Pilates training is performed by a physiotherapist, the duration of the study and the sessions are compatible with the literature, the cases are informed about the Pilates technique practically before the training program, there is a control group, and the study is randomized controlled. The strengths of this study were that performing the exercises under the guidance of a physiotherapist, evaluating physical fitness parameters by the physiotherapist, including people with similar fitness levels in the exercise program, and supporting people with different exercise methods needed, taking into account the needs and ages of the group.

5.6. Limitations

The study was conducted on female subjects only. Therefore, the gender specific differences were not studied. In addition, only women in a limited age range were included in the study. Furthermore, the study was conducted only with sedentary women.

Core stabilization could be evaluated in all groups.

It could not be followed whether the 8-week training periods would make a difference in the effectiveness of the follow-up process and what the results of the long-term follow-up would be. In addition, there is a great need for research on what kind of changes Pilates exercises combined with aerobic exercises will demonstrate on body composition, physiological and physical performance parameters.

6. CONCLUSION AND SUGGESTIONS

Consequently, when the effect of a Pilates exercise program on physical fitness parameters was examined, it was seen that while it had high positive effects on static-dynamic balance and flexibility values compared to SG and CG. In addition, it contributed low effect on aerobic capacity and agility values compared to CG. When the effect of swimming exercise program on physical fitness parameters was examined, it was observed that while it had higher effects on aerobic capacity and agility values compared to SG and CG. In addition, it contributed low effect on static-dynamic balance and flexibility values compared to CG. It can be said that the exercises applied in line with this result cause many changes in sedentary women. We can say that these and similar exercises should be done regularly for the continuation of these changes, improving physical fitness, and an ideal body and health. Based on this, we think that many health problems that may arise in older ages can be overcome. The main conclusion of the study is that both exercise modalities are generally effective in improving physical fitness performance parameters, but Pilates will be more appropriate when specifically flexibility and balance are desired to be developed, and swimming will be more appropriate when it is desired to develop aerobic capacity and agility. Consequently, swimming exercise has a positive effect on body composition, respiratory and circulation parameters, as well as performance parameters such as aerobic capacity and agility. Considering that these parameters are related to performance, it will give useful ideas to trainers, athletes and sports scientists in the preparation of training programs.

Combined with the benefits of strength, flexibility and balance training, Pilates exercise offers an unusually multidimensional workout. Many aerobic exercises, such as walking or swimming, offer little of these benefits. Thus, performing Pilates and aerobic exercises together creates a whole exercise regimen, usually without the need for stretching and balance work separately. Therefore, Pilates exercise and aerobic exercise complement each other, but do not replace each other (106).

Physical fitness performance parameters are related to age, gender, and physical activity. The decrease in physical activity gradually increases with age due to the decrease in the elasticity of soft tissue. Therefore, individuals should be encouraged to do physical exercises, especially flexibility exercises at least 3 times a week against this decrease in elasticity (86).

Making exercise a lifestyle is one of the key points in creating healthy societies. Healthier societies will be created by structuring exercise programs suitable for individuals by relevant health professionals and delivering them to the public through community-based projects. At this point, the main task for us health professionals is to ensure that these projects are increasingly popularized and maintained (107).

Suggestions

The following suggestions were made to help researchers who want to work on this subject in the future.

1. Comparisons between age groups and genders can be made by applying Pilates and swimming exercises to men and women in different age groups.

2. New studies can be done by changing the load intensity in the Pilates and swimming program applied to sedentary women. Thus, new findings can be reached regarding the effects of Pilates and swimming exercises performed at different loading intensities on body composition and performance parameters.

3. Studies can be conducted on the effects of different aerobic and anaerobic loads applied to sedentary women on body composition and motor performance parameters.

4. When the literature studies are examined, the effectiveness of in-water exercise programs on various diseases has been determined. However, a sufficient number of studies of healthy individuals have not been found. More study can be done on this subject.

It will be important for physiotherapists to play a more active role in the planning of exercise programs. Physiotherapists should explain physical fitness, muscle functions, body mechanisms, muscle tests and therapeutic exercises to healthy individuals, and individuals should be encouraged to participate in appropriate exercise programs.

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8. APPENDICES

APPENDIX A: ETHICAL APPROVAL

YEDİTEPE ÜNİVERSİTESİ
GİRİŞİMSEL OLMAYAN KLİNİK ARAŞTIRMALAR
ETİK KURULU

Versiyon No 2.0
13.02.2022
Sayfa 2 / 2

BAŞVURU NUMARASI: 202202171

KARAR 17.03.2022

☒ **KABUL**	☐ **RET** ☐ *KAPSAM DIŞI (GİRİŞİMSEL)* ☐ *BİLİMSEL VE/VEYA ETİK KURALLARA AYKIRI* ☐ *BİR SORUMLU ARAŞTIRMACININ (TEZ İSE TEZ DANIŞMANI), BİR TOPLANTIYA **İKİ (2) ADETTEN FAZLA ÇALIŞMA BAŞVURUSUNDA** BULUNMASI* ☐ *KURUM İÇİ BAŞVURULARINDA **KURUMSAL E-POSTA HESABI** İLE GİRİŞ YAPILMAMIŞ OLMASI* ☐ *ŞARTLI KABULDE BELİRTİLEN REVİZYONLARIN ZAMANINDA VE/VEYA İSTENİLDİĞİ ŞEKİLDE YAPILMAMIŞ OLMASI*

Yeditepe Üniversitesi Girişimsel Olmayan Klinik Araştırmalar Etik Kurulu adına
Prof. Dr. Didem Özdemir ÖZENEN
Başkan

Araştırmanın Başlığı	Rekreasyonel olarak düzenli klinik pilates egzersizi yapan ve düzenli yüzen sağlıklı kadınlarda denge, esneklik, aerobik kapasite ve çeviklik performanslarının karşılaştırılması
Araştırmacılar	Fzt. Kübra Paçacı, Dr. Öğr. Üyesi Ayça Aklar

APPENDIX B: INFORMED WRITTEN CONSENT

Bilgilendirilmiş Gönüllü Olur Formu ve Katılımcı Onam Formu

BİLGİLENDİRİLMİŞ GÖNÜLLÜ OLUR FORMU

Sayın katılımcı,

Davet edildiğiniz ‘’ Rekreasyonel olarak düzenli klinik Pilates egzersizi yapan ve düzenli yüzen sağlıklı kadınlarda denge, esneklik, aerobik kapasite ve çeviklik performanslarının karşılaştırılması’’ isimli bu çalışma; Yeditepe Üniversitesi Sağlık Bilimleri Enstitüsü Spor Fizyoterapisi Bölümü tarafından yürütülmektedir. Araştırmanın yürütücüsü Fzt. Kübra Paçacı ve sorumlu araştırmacı Dr. Öğr. Üyesi Ayça Aklar Çörekçi’dir.

Bu çalışmanın temel amacı, sağlıklı kadınlarda klinik Pilates egzersizleri ve yüzme egzersizi yöntemleri arasındaki herhangi bir üstünlüğü ortaya koymak için iki egzersiz metodunun fiziksel uygunluk performansları (denge, esneklik, aerobik kapasite (dayanıklılık) ve çeviklik) üzerindeki etkilerini belirlemek ve karşılaştırmaktır. Bu araştırmada katılımcılar egzersiz öncesi ve sonrası olmak üzere 2 kez 5 ayrı performans testiyle değerlendirilecektir. Değerlendirmelerden elde edilen denge, esneklik, aerobik kapasite ve çeviklik ölçütlerinin verileri bilgisayara kaydedilecek ve sonuçlar analiz edilecektir. Katılımcıların kimlikleri ve verileri gizli tutularak kamuoyuna açıklanmayacaktır. Bu çalışmaya klinik tanısı olmayan 30 katılımcıyı kaydetmeyi hedefliyoruz.

Katılımın isteğe bağlı olduğunu ve katılmayı reddetmenin herhangi bir cezaya veya herhangi bir menfaat kaybına yol açmayacağını belirtmek isteriz. Aynı şekilde istediğiniz zaman araştırmadan çekilebilirsiniz. Araştırmamızda katılımcılara uygulanan değerlendirmelerin bilinen herhangi bir zararı bulunmamaktadır. Değerlendirme sürecinde herhangi bir beklenmedik hasar olması durumunda, bilgiler size derhal verilecektir. Katılımcıların herhangi bir zarar görmesi durumunda gerekli başvurular herhangi bir rücu olmaksızın araştırmacılar tarafından karşılanacaktır. Bunun için ne sizden ne de sosyal güvenlik sigortanızdan herhangi bir ücret talep edilmeyecektir. Araştırmaya katılmak size hemen yardımcı olmamakla birlikte, araştırma sonuçlarımızın gelecekte organizasyon, toplum veya bilim için faydaları olacağı umulmaktadır. Araştırmanın amaçları veya bağlı olduğunuz sosyal güvenlik kurumu için sizden herhangi bir ücret alınmayacaktır.

Danışman:	Araştırmacı:
Dr. Öğr. Üyesi Ayça Aklar Çörekçi	**Fzt. Kübra Paçacı**
Yeditepe Üniversitesi	Yeditepe Üniversitesi
Sağlık Bilimleri Fakültesi	Sağlık Bilimleri Enstitüsü
Fizyoterapi ve Rehabilitasyon Bölümü	Spor Fizyoterapisi Bölümü
Tlf: 0216 578 0000 / 3289	Tlf: 0543 328 80 86

Katılımcı Onam Formu

Bu anket, Yeditepe Üniversitesi Sağlık Bilimleri Enstitüsü, Spor Fizyoterapisi Bölümü, Yüksek Lisans Tezi için hazırlanan ‘’**Rekreasyonel olarak düzenli klinik Pilates egzersizi yapan ve düzenli yüzen sağlıklı kadınlarda denge, esneklik, aerobik kapasite ve çeviklik performanslarının karşılaştırılması.**" adlı araştırma kapsamında yapılmaktadır. Araştırma kapsamında çalışmaya katılmayı kabul eden 30 kişiden oluşan gönüllü bireylere Y denge testi ile dinamik denge değerlendirmesi, Stork stand test ile statik denge değerlendirmesi, Otur ve Eriş testi ile esneklik değerlendirmesi, 20 m mekik koşu testiyle aerobik fitness değerlendirmesi ve Altıgen testi ile çeviklik değerlendirmesi uygulanacaktır. Çalışmamızda olgular üç gruba ayrılacaktır. Birinci grup (G1) 45-60 dk seanslar şeklinde haftada 3 gün olmak üzere 8 hafta boyunca Pilates egzersizi yapan kadınlar, ikinci grup (G2) 45-60 dk seanslar şeklinde haftada 3 gün olmak üzere 8 hafta boyunca yüzen kadınlar ve üçüncü grup (G3) kontrol grubu olmak üzere fiziksel fitness performans parametreleri karşılaştırılması amacıyla uygulanacaktır. Her olgu için testler tek seansta yapılarak, ölçümler kayıt edilecektir. Araştırmaya katılacak gönüllülere uygulanacak yöntemlerin hiçbir risk veya yan etki oluşturma olasılığı yoktur. Araştırmaya katılmak tamamen gönüllülük esasına dayalı olup gönüllülerin çalışmaya katılmakla parasal yük altına girmeyecek ve herhangi bir ödeme de yapılmayacaktır. Gönüllüler sadece araştırmacı tarafından ayarlanan programa uymakla sorumludurlar. Gönüllünün araştırmaya katılımı isteğe bağlıdır ve gönüllünün istediği zaman, herhangi bir cezaya veya yaptırıma maruz kalmaksızın, hiçbir hakkını kaybetmeksizin araştırmaya katılmayı reddedebileceği veya araştırmadan çekilebileceği, araştırmadan çıkarılması veya çıkması halinde, egzersizleriyle ilgili bir aksama olmayacağı güvencesi tarafımızdan verilmektedir. Araştırmada yapılan değerlendirmelerin sonuçları yalnızca araştırma kapsamındaki çalışmalarda kullanılacaktır. Kişisel bilgileriniz herhangi bir amaçla,

kurum yöneticileri veya üçüncü kişilerle paylaşılmayacaktır. Katılımınız için teşekkür ederiz.

Danışman Öğretim Üyesi: Asist. Prof. Ayça AKLAR ÇÖREKÇİ

Araştırmacı: Fzt. Kübra PAÇACI

Bilgilendirilmiş gönüllü olur formundaki tüm açıklamaları okudum. Bana yukarıda konusu ve amacı belirtilen araştırma ile ilgili yazılı ve sözlü açıklama aşağıda adı belirtilen araştırmacı tarafından yapıldı. Araştırmaya gönüllü olarak katıldığımı, istediğim zaman gerekçeli veya gerekçesiz olarak araştırmadan ayrılabileceğimi biliyorum. Söz konusu araştırmaya, hiçbir baskı ve zorlama olmaksızın kendi rızamla katılmayı kabul ediyorum.

Bu çalışma sonuçlarının kullanılmasını kısıtlamamayı, yayın, rapor ve benzeri bilimsel dokümanlarda kullanılmasını kabul ediyorum. İster doğrudan, ister dolaylı olsun araştırma uygulamasından kaynaklanan nedenlerle meydana gelebilecek herhangi bir sağlık sorunumun ortaya çıkması halinde, her türlü tıbbi müdahalenin sağlanacağı konusunda gerekli güvence verildi.

Gönüllü Adı / Soyadı /Adres/ Telefon Numarası / Tarih / İmzası

Tanık Adı / Soyadı /Adres/ Telefon Numarası / Tarih / İmzası

Yürütücü Araştırmacı Adı / Soyadı /Adres/ Telefon Numarası / Tarih / İmzası

Sorumlu Araştırmacı Adı / Soyadı /Adres/ Telefon Numarası / Tarih / İmzası

Katılımcıya çalışma ve yapılacak işlemler hakkında gerekli bilgileri verdim. Katılımcının bu bilgileri anladığına, sormak istediği soruları sorduğuna, özgür iradesiyle süreci Kabul ettiğine inanıyorum.

Araştırmacı: Fzt. Kübra Paçacı **Adres:** Fizyoroyal Fizik Tedavi Kliniği **Tlf:**

Email: **Tarih:** **İmza:**

APPENDIX C: STRUCTURED QUESTIONNAIRE

Yeditepe Üniversitesi
Sağlık Bilimleri Enstitüsü
Spor Fizyoterapisi Bölümü

Bölüm 1. Demografik Özellikler **Tarih:** …/….. /……

1)Hastanın Adı Soyadı: ……

2)Yaş:

3) Cinsiyet: ( ) Kadın ( ) Erkek

4) Boy uzunluğu (cm):

5) Vücut ağırlığı (kg) :

6) Dominant taraf: El ( ) sağ ( ) sol

Ayak ( ) sağ ( ) sol

7)Medeni Durumunuz: ( ) Hiç evlenmemiş / Bekar ( ) Evli

( ) Boşanmış / Dul ( ) Ayrı yaşıyor

8) Eğitim durumunuz

İlkokul ☐
Ortaokul ☐
Lise ☐
Üniversite ve üzeri ☐

9) Mesleğiniz:

10)Maddi durumunuz:

1000TL'den az ☐ 1000-2000TL ☐ 2000-3000TL ☐ 3000TL ve üzeri ☐

11) Sosyal güvenceniz:

Var ☐ Yok ☐

12) Çocuğunuz : ( ) var ( )yok Varsa kaç çocuğunuz var.....

13) a) Sigara kullanıyor musunuz?

( )Hiç içmedim ( )Sigara içtim ama bıraktım ( )Halen içiyorum

b) Günde kaç adet sigara içiyorsunuz?.....adet/gün

Sigara: .....Paket/Yıl

14) Alkol kullanıyor musunuz? ( ) Evet ( ) Hayır

Hangi sıklıkla?.....

15) Gözlük kullanıyor musunuz? ( )Evet ( ) Hayır

16) Herhangi bir sürekli hastalığınız (boyun ağrısı dışında) var mı? Varsa hangileri?

( ) Sürekli bir hastalığım yok

( ) Romatizma ( ) Ortopedik hastalık ( ) Nörolojik problemler

( ) Travma ( ) Diğer.....

17) İlaç kullanıyor musunuz?.....

Kullanıyorsanız, kullandığınız ilaçlar nelerdir?.....

18) Kullandığınız ilaçların dozu nedir? ...../Günde ...../Haftada

19)Şu an herhangi bir ağrı kesici ilaç kullanıyor musunuz? ( ) Evet ( ) Hayır

Evet ise ne zamandır?.....

20)Herhangi bir ameliyat geçirdiniz mi? ( ) Evet..... Belirtiniz ( ) Hayır

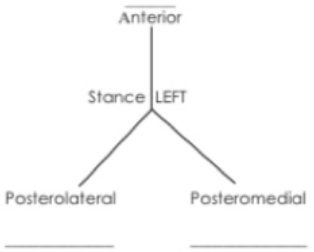
21)Hiç kaza gecirdiniz mi ? ( ) Evet.....Belirtiniz ( ) Hayir

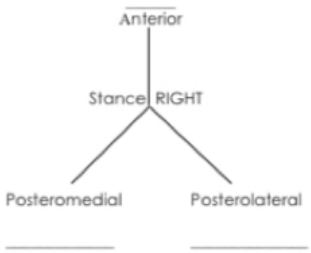
22) Vücudunuzda ağrı hissediyor musunuz?

Nerede ?

Ne zamandır?

APPENDIX D: Y BALANCE TEST FORM





	Sol	Sağ	Fark
Anterior			
Posteromedial			
Posterolateral			

Total skor = $\frac{(\text{Anterior} + \text{Posteriomedial} + \text{Posterolateral})}{(3 \times \text{Limb Length})} \times 100$

Total		
Sağ		
Sol		

APPENDIX E: STORK STAND TEST

Sağ	Sol

APPENDIX F: SIT AND REACH TEST

CM

APPENDIX G: THE 20 M SHUTTLE RUN TEST

Süre	Mekik

APPENDIX H: THE HEXAGON TEST

Süre / Saniye