Spor ve Performans Araştırmaları Dergisi,
Journal of Sports and Performance Researches

e-ISSN: 1309-8543 Spor ve Performans Araştırmaları Dergisi,
Ağustos 2024, 15(2): 265-276

Investigation of Fear of Falling, Balance and Some Physical Parameters of Ai Chi and Modified Core Exercises in Sedentary Women

Sedanter Kadınlarda Ai Chi ve Modifiye Core Egzersizlerinin Düşme Korkusu, Denge ve Bazı Fiziksel Parametrelerin İncelenmesi

Esin Çağla ÇAĞLAR[1]

[1]Hitit Üniversitesi, Spor Bilimleri Fakültesi, Beden Eğitimi ve Spor Bölümü, Beden Eğitimi ve Spor Anabilim Dalı Çorum
· **esincaglacaglar@hitit.edu.tr** · ORCİD > 0000-0002-2717-0830

Makale Bilgisi/Article Information

Makale Türü/Article Types: Araştırma Makalesi/Research Article
Geliş Tarihi/Received: 17 Nisan/April 2024
Kabul Tarihi/Accepted: 19 Ağustos/August 2024
Yıl/Year: 2024 | **Cilt – Volume:** 15 | **Sayı – Issue:** 2 | **Sayfa/Pages:** 265-276

Atıf/Cite as: Çağlar, E.Ç. "Investigation of Fear of Falling, Balance and Some Physical Parameters of Ai Chi and Modified Core Exercises in Sedentary Women" Ondokuz Mayıs University Journal of Sports and Performance Researches, 15(2), Ağustos 2024: 265-276.

Etik Kurul Beyanı/Ethics Committee Approval: "Araştırma için Hitit Üniversitesi Girişimsel olmayan Etik Kurulu'ndan 28.02.2024 tarihli ve 2024-04 karar sayısı ile etik kurul izni alınmıştır."

https://doi.org/10.17155/omuspd.1469954

INVESTIGATION OF FEAR OF FALLING, BALANCE AND SOME PHYSICAL PARAMETERS OF AI CHI AND MODIFIED CORE EXERCISES IN SEDENTARY WOMEN

ABSTRACT

The aim of this study was to determine the effects of Ai Chi and modified core exercises on balance and fear of falling. Forty-four women participated in the study. The average age of the participants was 58.75±7.40 years. Mean body weight was 73.57±12.81 kg and mean height was 158.64±6.27 cm. Ai Chi and modified core exercises were performed in two different groups for 6 weeks, 3 days a week for 1 hour each at 35-54% of heart rate reserve. No exercise programme was performed in the control group. As part of the study, the balance and fear of falling scales, height, body composition analysis and the circumferences of the chest, hips, waist and thighs were measured before and after the study. In the pre-post test comparison of the physical measurement parameters of the Ai-chi exercise group, a significant difference was found in waist circumference, hip circumference and sitting and reach data ($p<0.05$). A significant difference was found in body weight, waist circumference, hip circumference and sit and reach parameters after the pre-post-test measurements of the modified core training ($p<0.05$). The effects of the control and training groups on the physical measurement parameters were analysed. The results showed that there was a significant difference in body weight, chest, waist, hip circumference and sit and reach data ($p<0.05$). As a result of the study, the safe use of Ai Chi and modified core exercises in this age group can be recommended as it brings about an improvement in health problems.

Keywords: Ai Chai, Modified Core Exercise, Sedanters.

❋❋❋

SEDANTER KADINLARDA Aİ CHİ VE MODİFİYE CORE EGZERSİZLERİNİN DÜŞME KORKUSU, DENGE VE BAZI FİZİKSEL PARAMETRELERİN İNCELENMESİ

ÖZ

Bu çalışmanın amacı Ai Chi ve modifiye core egzersizlerinin denge ve düşme korkusu üzerindeki etkilerini tespit etmektir. Çalışmaya 44 kadın katılmıştır. Katılımcıların yaş ortalaması 58,75±7,40 yıldır. Vücut ağırlığı 73,57±12,81 kg ve boy uzunluğu 158,64±6,27 cm'dir. Ai Chi ve modifiye core egzersizleri iki farklı gruptaki katılımcılara 6 hafta boyunca, haftada 3 gün, 1'er saat süreyle kalp atım hızı rezervinin %35-54'ünde uygulandı. Kontrol grubuna ise herhangi bir egzersiz

programı uygulanmadı. Çalışma kapsamında katılımcıların çalışma öncesi ve sonrasında denge ve düşme korkusu ölçeği, boy uzunluğu, vücut kompozisyon analizi ve göğüs, kalça, bel ve uyluk çevresi ölçümleri yapılmıştır. Ai Chi egzersiz grubunun fiziksel ölçüm parametrelerinin ön-son test karşılaştırmasında bel çevresi, kalça çevresi ve otur uzan verilerinde anlamlı bir fark bulunmuştur ($p<0,05$). Modifiye core egzersizi ön-son test ölçümleri sonrasında vücut ağırlığı, bel, kalça çevresi ve otur uzan parametrelerinde anlamlı bir fark bulunmuştur ($p<0,05$). Kontrol ve egzersiz gruplarının fiziksel ölçüm parametreleri üzerindeki etkileri analiz edilmiştir. Sonuçlar, vücut ağırlığı, göğüs, bel, kalça çevresi ve otur ve uzan verilerinde anlamlı bir fark olduğunu ortaya koymuştur ($p<0,05$). Çalışmanın sonucunda, Ai Chi ve modifiye core egzersizlerinin bu yaş grubunda güvenli bir şekilde kullanılmasının sağlık sorunlarında iyileşme sağlaması nedeniyle tavsiye edilebilir.

Anahtar Kelimeler: Ai Chai, Modifiye Core Egzersiz, Sedanterler.

❋❋❋

INTRODUCTION

Exercise, which occupies an important place for sedentary people, disrupts the physiological and physical structure of the individual, such as cognitive disorders, reduced quality of life and withdrawal from social life, leading to a decrease in bone and muscle mass. In recent years, Ai Chi, a water therapy-based exercise, has been shown to improve balance, increase muscle strength and improve the overall health of the elderly (Kurt et al, 2018; Liu et al, 2010; Güçlü et al, 2012; Kim et al, 2017). The aging process can lead to significant health problems such as loss of balance, fear of falling and reduced quality of life in women who lead a sedentary lifestyle. Exercise programs play an important role in combating these problems (Teng et al., 2024). Studies have shown that many treatments have been tried to increase muscle strength in individuals, but no success has been observed with treatments other than exercise therapy (Friedman & Tappen, 1991; Balsamo et al., 2013). Innovative and effective therapy methods such as Ai Chi and modified core exercises, which are among these types of rehabilitative and therapeutic exercises, have significant potential to improve the health and quality of life of sedentary women. With increasing age, health problems such as balance problems, declining muscle strength and reduced quality of life are often observed. Therefore, effective and safe exercise programs are important for people who lead a sedentary lifestyle. As a result of losses in the body, falls and gait disturbances can occur. These exercises, also known as core exercises, aim to increase muscle mass in older people and minimize the risk of falls and gait disturbances (Audette et al., 2006; Taylor-Piliae et al., 2010; Lauche et al., 2016; Arslan et al., 2024).

As evidenced in the literature, impaired balance, impaired gait and consequent loss of muscle strength are inevitable in sedentary females, and the importance of physical activity and resistance exercise is emphasized (Farid et al, 2016; Li et al, 2004; Gillespie & Friedman 2007; Küçük et al., 2024). Strength and muscle function are one of the most important factors for the human body and movement and play a fundamental role in preventing the risk of falls, difficulties in walking and related injuries and disabilities (Korkmaz et al, 2023). Stabilization of balance during exercise depends on a strong trunk (Asgharifar, 2009). Strengthening the core muscles by activating them plays an important role in preventing and improving many musculoskeletal injuries (Akuthota et al. 2004). To summarise, the results of the literature show that exercise has positive effects on various parameters, such as fear of falling and improving balance. Looking at the concepts related to this topic, fear of falling is a person's excessive worry about falling or low confidence in avoiding falls during daily activities (Stevens et al, 2006). In addition to the feelings of fear and anxiety triggered by the fall event, the actions taken by the person to avoid falling have negative effects that cause a decrease in confidence and mobility (Korkmaz et al, 2023). In addition, when examining the studies on Ai chi exercise and the subject in the literature, it was found to cause an improvement in the change of body composition, balance and many parameters (Pérez & Cruz 2021; Shou et al; 2019; Ho et al, 2013).

In reviewing the studies in the literature, it was found that there was no study on the effects of Ai Chi and modified core exercises on fear of falling, balance and some physical parameters in sedentary women. Ai Chi and modified core exercises are said to improve balance, reduce the fear of falling and positively change physical parameters in sedentary women. The aim of this study is to evaluate the effectiveness of Ai Chi and modified core exercises in improving the quality of life and health problems of sedentary women. The study also aims to uncover and compare the differences between land and water-based exercises on some parameters and to determine the effects of the different types of exercise on balance and fear of falling.

METHOD

Research Group (Population-Sample)

This study involved 45 sedentary women aged 35-50 years, 14 Ai Chi, 15 Modified Core and 16 control groups. However, for various reasons, 1 participant from the Ai Chi exercise group dropped out of the study, so the study was completed with the participation of 44 sedentary women. Voluntary informed consent was obtained from all participants prior to the study. This study was approved by the non-interventional ethics committee of Hitit University Non-invasive Ethics Committee with decision number 2024-04 dated February 28, 2024.

Data Collection

Within the scope of the study, measurements were taken from the control and study groups twice, before and after the exercise program. While no exercise program was applied to the control group, Ai Chi and Modified Core exercises were applied to the Ai Chi and Modified Core exercise study groups for 6 weeks, 3 days a week, 1 hour each, at 35-54% of the heart rate reserve, and the carvonen formula was used to determine the exercise intensity (Zorba & Saygın, 2013). Karvonen was calculated as follows: Target Heart Rate (HR)= Exercise intensity (%)x (Maximal heart rate= 220-age (MVPA)- Resting heart rate (HRR))+ HRR.

Table 1. Ai chi exercise program

Weeks	Training Scope	Ai Chi Group Exercises		
		Main Phase Name of Exercise	Ingredients	Repeat*Set
6 Weeks	5 min. warm-up 35-40 min. main phase 5 min. cool down	• Thinking • Containment • Lifting up • Folding • Aggregation • Scrolling • Becoming a ring • Balancing • Rotational energization • Feeding • Flowing • Reflection • Suspension	(Exercises Mini pool pasta, various apparatus).	Each movement consists of repetitions lasting 1 minute

Table 2. Modified core exercises program

Weeks	Training Scope	Modified Core Exercises Group Exercises		
		Main Phase Name of Exercise	Ingredients	Repeat*Set
6 Weeks	5 min. warm-up 35-40 min. main phase 5 min. cool down	• Mini- Squad • Roll Down • Abdominal Preparation Exercise • Shoulder Bridge • Clam • One Leg Stretch • Arm Openings • Hip Twist • Side Kick • The Saw • Lumbar Mobility • Chest Stretch • Hunders • Cat Stretch • Corkscrew	(Exercises were diversified with auxiliary apparatus such as mini ball, resistance tire, hoop etc.)	10x2

Data Collection Tools

Measurement of height: The athletes' height was measured with a stadiometer (SECA 0123 Made in Germany) after they had taken a deep breath. The feet were bare and together, the knees straight and extended, heels, shoulder blades and hip bones in contact with the device, the head in the Frankfurt plane (parallel to the floor, eye triangle and auricle tip aligned). In addition, all participants wore comfortable and light clothing.

Body Composition Analysis: The athletes' body composition was analysed with the bioelectrical impedance method using the Tanita Body Composition Analyzer BC 418. This method was used to determine body weight, body fat percentage, lean body mass, total body water and body mass index for all participants (Kelly & Metcalfe, 2012).

Circumference measurements: A flexible, non-elastic 7 mm wide measuring tape with an accuracy of 0.1 cm was used for circumference measurements (Jakobsen et al., 2010).

Chest Circumference: The measurements were taken in a standing position with the arms bent. The measurement was taken at the level of the 4th costal arch, which runs through the lower end of the shoulder blade on the back (Norton, 2018).

Hip Circumference: The measurements were taken at the front of the pubic symphysis and at the back at the most protruding point of the gluteal region (Norton, 2018).

Waist Circumference: Measurements were taken at the level of the navel, in the subcostal region at the sides in a standing position, with arms outstretched to the side (Norton, 2018).

Upper Leg Circumference (thigh): While the athlete stood in an upright position with both feet pressed evenly together, the measuring official stood on the athlete's right side. The circumference was measured at the end of the hip crease (Günay et al., 2013).

Balance: The Berg Balance Scale (BBS) was used to assess dynamic balance status. The BBS consists of 14 items. For each item, the degree of competence in the activity is indicated with 5 different scores (0-4), where 0 means "cannot" and 4 means "independent and confident". The 14 functional parameters included in the BBS are: everyday functional tasks such as rising from a seated position, free standing with eyes open, free sitting, moving from a standing position to a seated position, transfers, free standing with eyes closed, free standing with feet together,

reaching forward with arms flexed at 90º while standing, picking up an object from the floor, turning to look backward over the right and left shoulders, turning 360º, alternating stepping on a step, performing a free-standing tandem stance, and standing on one leg. The time required for the test is approximately 15-20 minutes. A digital stopwatch, a 30 cm long ruler, a 20 cm high board, a 42 cm high chair with backrest and armrests and a 42 cm high chair without backrest and armrests were used for the test. Each functional parameter was explained individually by showing it to the subject. Subjects were asked to perform all parameters and the score obtained for each parameter was recorded on the score sheet. The total score was calculated by adding the scores of all parameters. The maximum score a person can achieve in this test is 56 (0-20 points: severe fall risk, 21-40 points: moderate fall risk, 41-56 points: low fall risk) (Şahin et al., 2008).

Fear of Falling Activity Scale: Based on the premise that fear of falling is measurable, Tinetttive et al. (1990) developed the Fall Efficacy Scale to assess older people in terms of their fall-related efficiency or safety in their daily activities. In this ten-point scale, respondents rate each question on a scale from 1 (very confident) to 10 (not at all confident). When all scores are added together, the total score is between 1 (high fall-related effectiveness) and 100 (low fall-related effectiveness) (Gillespie & Friedman, 2007).

Data analysis: Data were collected using SPSS 22 package program. In order to test whether there was a difference in the physical parameters and scales as a result of the exercise, the basic statistical values were examined and the test results were tested with Kolmogrov-Smirnov to determine whether the variables showed normal distribution. As a result of this test, the data showed normal distribution. Repeated Measure ANOVA was used for multiple comparisons.

FINDINGS

A total of 44 people participated in the study. The mean age of the participants was 58.75±7.40 years. The mean body weight was 73.57±12.81 kg and the mean height was 158.64±6.27 cm.

Table 1. Comparison of physical measurement parameters between groups

	Groups	n	Pre Test		Post Test		f	p
			Mean	Sd.	Mean	Sd.		
Body Weight (Kg)	Ai Chi	14	72.02	12.78	71.62	12.63	9.216	**0.004**
	Modified	15	75.36	13.59	76.25	13.46		
	Control	16	73.27	12.73	74.45	12.80		

Breast Measurement (cm)	Ai Chi	14	110.00	8.93	108.64	8.70	5.467	**0.008**
	Modified	15	112.27	8.83	113.07	7.48		
	Control	16	101.25	7.88	102.38	7.86		
Waist Circumference	Ai Chi	14	86.29	16.59	84.93	16.68	13.748	**<0.001**
	Modified	15	92.87	17.73	91.33	18.13		
	Control	16	89.44	14.22	90.75	14.12		
Hip Circumference	Ai Chi	14	115.57	11.09	113.86	10.77	12.222	**<0.001**
	Modified	15	116.00	8.39	114.93	8.45		
	Control	16	108.31	5.93	108.81	5.87		
Thigh Measurement	Ai Chi	14	57.71	9.67	56.14	10.84	1.104	0.341
	Modified	15	59.07	6.11	58.80	6.13		
	Control	16	55.63	5.19	55.81	5.04		
Sit and Reach	Ai Chi	14	17.29	3.56	18.93	3.63	10.731	**<0.001**
	Modified	15	16.20	3.69	16.73	3.69		
	Control	16	14.69	2.91	14.75	2.96		

The effects of control and exercise groups on physical measurement parameters were analyzed. The results revealed a significant difference in Body Weight, Breast, Waist, Hip circumference and Sit and reach data ($p<0.05$).

Table 2. Comparison of fall activity and Berg balance scale between groups

	Groups	**n**	**Pre Test**		**Post Test**		**f**	**p**
			Mean	**Sd.**	**Mean**	**Sd.**		
Fall Activity	Ai Chi	14	61.93	6.31	57.07	6.11	25.807	**<0.001**
	Modified	15	59.60	7.37	56.60	6.93		
	Control	16	54.69	6.97	54.69	6.91		
Berg Balance Scale	Ai Chi	14	34.00	4.51	41.64	3.39	6.482	**0.004**
	Modified	15	33.40	4.42	37.27	7.75		
	Control	16	33.50	4.08	33.81	3.10		

There was a significant difference between the groups in Fall activity and Berg balance scale parameters in the pre-post test ($p<0.05$).

DISCUSSION

Health problems such as loss of balance, fear of falling, and reduced physical performance are frequently observed in women with sedentary lifestyles during the aging process. In this context, evaluating the effects of exercise modalities such as Ai Chi and modified core exercises on fear of falling, balance, and physical parameters in sedentary women is an important step towards improving quality of life and health status. Research indicates that Ai Chi has been effective in reducing the risk of falling and has the potential to improve the quality of life in sedentary women, along with positive effects on balance (Gürpınar et al., 2018). Additionally, studies have reported that modified core exercises can reduce fear of falling and improve balance in sedentary women (Atıcı, 2019). It is also stated that Ai Chi and modified core exercises have positive effects on fear of falling, balance and physical parameters in sedentary women (Atıcı, 2019). In this study, the effects of Ai Chi and modified core exercises on fear of falling, balance and some physical parameters in sedentary women were investigated. When the results were examined, a significant difference was found in waist circumference, hip circumference, and flexibility measurements in the Ai Chi exercise group (Table 1). Our results show that Ai Chi has positive effects on waist and hip circumference and can increase flexibility. Looking at the literature studies, we find that aquatic exercise includes balance, improving fear of falling and its effects (Teng et al; 2024; Canever et al, 2021; Sun et al, 2021; Sattin et al, 2005; Li et al, 2004). When examining the literature studies on the effect of Ai Chi on body composition, the study conducted by Çağlar (2022) confirmed that water exercise performed regularly three days a week produced statistically significant improvements in various physical parameters such as body weight, body mass index, lean body mass, flexibility, balance, fat mass, chest, hip and waist circumference, and body fat percentage. It was reported that Ai Chi and aquatic therapy as well as aquatic therapy with land exercise were effective in improving pain, balance and gait in patients with chronic paralysis, increasing their functional capacity and quality of life (Pérez & Cruz 2020). In another study, Türkmen & Çağlar (2022) demonstrated the positive effects of water and step aerobic exercises on flexibility in an 8-week study of sedentary individuals and observed significant improvements in all flexibility parameters. These results suggest that Ai Chi can regulate fat distribution in certain parts of the body and increase flexibility. This study showed that the 6-week Ai Chi exercise program had positive effects on body weight, some body measurements, waist and hip circumference, and flexibility (Table 1). We think this is due to the resistance of water against the body due to the type of exercise performed.

In this study, a significant difference was observed in the fall activity and balance measurements before and after the intervention in the Ai Chi training group ($p<0.05$) (Table 2). When examining the literature studies on the effect of Ai Chi exercise on fall activity and balance, the effectiveness of Ai Chi on balance perfor-

mance in individuals with chronic paralysis compared with traditional water-based exercise was investigated, and it was reported that Ai Chi is suitable for balance in paralysis and improves weight transfer in the anteroposterior axis, functional balance, and lower limb control (Ku et al, 2020). Another study showed that Ai-chi exercises are an effective method for improving balance and functional capacity in geriatric individuals (Gürpınar et al, 2018). Aidar et al. (2006) obtained results showing that physical exercises performed in water for 12 weeks can increase functional independence. Since Ai Chi is a sport that consists of slow and fluid movements, we think that these movements can contribute to improving balance. Due to the nature of the movements, factors such as improving proprioception, enhancing self-confidence and improving concentration may support the positive effects of Ai Chi on balance. We therefore hypothesise that Ai Chi exercises may help to reduce balance problems and reduce the risk of falls in older people. Our study results may show that Ai Chi exercises have positive effects on balance and fall activity.

A significant decrease in waist and hip circumference was observed in the group with the modified core training program. This shows that the exercise program is effective in reducing fat accumulation around the waist and hips. These reductions could indicate that the exercise program effectively changed body composition. A significant increase was also observed in the sit and reach measurements in the training group (Table 1). This indicates that movement increases the body's flexibility and that it is important to maintain this flexibility. Overall, it can be concluded that modified core training has positive effects on body weight, waist and hip circumference and flexibility. When examining the literature studies on the effect of modified core training on body composition, it was found that in the study conducted by Atıcı (2019) to investigate the effect of modified core training on quality of life, fall risk and some physical fitness scores in Alzheimer's patients, no significant difference was found in body weight and body mass index data ($p>0.05$). Another study evaluated muscle activation during 4 basic and modified weight-bearing core strength exercises in athletes with amputation and showed a significant difference in muscle activation between the different sides of the body (Liu et al, 2024).

In this study, a significant difference was found in fall activity and balance parameters in the modified core training group (Table 2). If we evaluate these results, it can be assumed that the decrease in fall activity and the increase in the balance parameter are due to the effects of the type of training on balance, muscle strength and coordination. The modified core training program includes movements that improve balance and strengthen the core at the same time. Therefore, the training program can effectively reduce the risk of falling and improve balance at the same time. When examining the literature studies on the effect of modified core training on fear of falling and balance, it was found that a study conducted to evaluate the effect of core stability exercise on balance in patients with multiple sclerosis showed positive and significant improvements in static and dynamic

balance (Farid et al, 2016). Altındal (2021) investigated the effectiveness of hip abductor strengthening and normal joint motion exercises with elastic band on core endurance and functional performance in 66 healthy young people and reported that resistance exercises effectively increased flexibility, lower extremity strength, balance, core endurance and abductor strength. In another study, core stabilization exercises significantly improved balance and proprioception skills in a 6-week training period (Yılmaz, 2023). Özsoy (2019) reported that core stabilization exercises improve balance, walking and physical activity in the treatment of non-specific low back pain in the elderly. Core exercises performed on water have been found to have a positive effect on strength and balance parameters in female basketball players (Kaçar, 2019). Ege (2021) found that core training improved the strength and balance parameters of female soccer players. In contrast to these results, Eriş (2018) reported in his study that core strength training increased core strength but did not contribute to static balance. According to this result, it can be said that the type of exercise performed provides different results depending on the age group and duration. By examining the literature, it can be said that core strength exercises are important to improve balance.

CONCLUSION AND RECOMMENDATIONS

The results of our study showed that there were significant differences between the different exercise groups in the parameters of fall activity and balance. The different results between the different exercise groups could be related to the type and content of the exercise. For example, Ai Chi, which consists of slow and controlled movements, is known to improve balance, while other types of exercise may have different effects. Therefore, the characteristics of the exercise programs may affect the results. Although each group exercised for a certain amount of time, differences in the content of the exercises may affect the results between the groups. Although fall activity and balance levels were similar in each group at the beginning of the study, the effects of the exercise programs were different. In summary, these results appear to be based on several factors, such as the characteristics of the different exercise groups, the characteristics of the exercise programs, and the initial condition of the participants. The combination of these factors helps to explain the different results between the different groups.

It is important to note that our study was limited to a specific age group, namely older adults with sedentary lifestyles. As a result of the study, the safe use of Ai Chi and modified core exercises in this age group can be recommended due to the improvement in health problems.

Conflict of Interest Statement

There is no personal or financial conflict of interest within the scope of the study.

REFERENCES

Altındal, F. (2021). Sağlıklı gençlerde kalça abdüktörlerinin propriyoseptif nöromusküler patern ve therabant egzersizleri ile kuvvetlendirilmesinin core endurans ve fonksiyonel performans üzerine etkilerinin incelenmesi (Doktora Tezi, Pamukkale Üniversitesi).

Akuthota, B., Hughes, D., Zoughi, R., Myers, J., & Nanni, A. (2004). Near-field microwave detection of disbond in carbon fiber reinforced polymer composites used for strengthening cement-based structures and disbond repair verification. *Journal of materials in civil engineering, 16*(6), 540-546.

Aidar, F.S., Reis, A.J., Carneiro, V.M., & Leite, A.M. (2006). Elderly and old adult: Aquatic physical activities and functional autonomy. Fit Perform Journal, 5(5), 271-276.

Audette, J. F., Jin, Y. S., Newcomer, R., Stein, L., Duncan, G., & Frontera, W. R. (2006). Tai Chi versus brisk walking in elderly women. *Age and ageing, 35*(4), 388-393.

Arslan, Y., Yavaşoğlu, B., Beykumül, A., Pekel, A. Ö., Suveren, C., Karabulut, E. O., ... & Ceylan, L. (2024). The effect of 10 weeks of karate training on the development of motor skills in children who are new to karate. *Frontiers in Physiology, 15*, 1347403. https://doi.org/10.3389/fphys.2024.1347403

Asgharifar, S. (2009). *The comparison of core stability and agility between female handball players and ballet dancers* (Master thesis, Hacettepe Üniversitesi).

Atici, M. (2019). Alzheimer hastalarında modifiye core egzersiz çalışmalarının yaşam kalitesi, düşme korkusu ve bazı fiziksel uygunluk parametrelerine etkisinin incelenmesi (Doktora Tezi, Gazi Üniversitesi).

Balsamo, S., Willardson, J.M., Frederico, S., Prestes, J., Balsamo, D.C., & Dahan da, C.N. (2013). Effectiveness of exercise on cognitive impairment and Alzheimer's disease. Internal Journal of General Medicine, 24(6), 387-391.

Canever, J. B., Danielewicz, A. L., Leopoldino, A. A. O., Corseuil, M. W., & de Avelar, N. C. P. (2021). How much time in sedentary behavior should be reduced to decrease fear of falling and falls in community-dwelling older adults? Journal of Aging and Physical Activity, 30(5), 806-812.

Çağlar, E. Ç. (2022). An investigation of dance based aquatic and zumba exercise in sedentary women according to motoric and physiological parameters. Education & Youth Research, 2(2), 48-58.

Eriş, F. (2018). Kadın badminton sporcularında 12 haftalık core kuvveti egzersizlerinin bazı antropometrik değerler statik denge ve core kuvveti üzerine etkisinin araştırılması (Doktora Tezi, Yüzüncü Yıl Üniversitesi).

Ege, İ. E. (2021). Kadın futbolcularda 8 haftalık dinamik core antrenmanlarının kuvvet ve denge parametreleri üzerine etkisi ve takibinin incelenmesi (Yüksek Lisans Tezi, Aydın Adnan Menderes Üniversitesi).

Farid, R., Norasteh, A. A., & Hatamian, H. (2016). The effect of core stability exercise program on the balance of patients with multiple sclerosis. Caspian Journal of Neurological Sciences, 2(1), 9-17.

Friedman, R. Tappen, R.M. (1991). The effect of planned walking on communication in Alzheimer's disease. Journal of American Geriatric Society, 39(7), 650-654.

Güçlü Gündüz, A., Bayraktar, D., Yazıcı, G., Batur Çağlayan, H. Z., İrkeç, C., & Nazliel, B., (2012). "Multipl sklerozlu hastalarda pilates ve ai chi egzersiz yöntemlerinin etkilerinin karşılaştırılması". 48.Ulusal Nöroloji Kongresi, Antalya.

Gürpınar, B., Demirbüken, İ., Keleş, K. İ., & İlçin, N. (2018). Geriatrik bireylerde ai chi egzersizlerinin denge üzerine etkileri. Geriatrik Bilimler Dergisi, 1(3), 113-118.

Günay, M., Tamer, K., Cicioğlu, İ. (2013). Spor Fizyolojisi ve Performans Ölçümü. Gazi Kitabevi.

Gillespie, S. M., & Friedman, S. M. (2007). Fear of falling in new long-term care enrollees. Journal of the American Medical Directors Association, 8(5), 307-313.

Ho, R. T., Wang, C. W., Ng, S. M., Ho, A. H., Ziea, E. T., Wong, V. T., & Chan, C. L. (2013). The effect of t'ai chi exercise on immunity and infections: a systematic review of controlled trials. The Journal of Alternative and Complementary Medicine, 19(5), 389-396.

Kaçar, M. R. (2019). 8 haftalık su üzerinde core antrenmanın programının bayan basketbolcuların denge ve kuvvet parametreleri üzerine etkisinin incelenmesi (Yüksek Lisans Tezi, İstanbul Gelişim Üniversitesi).

Kelly, J., & Metcalfe, J. (2015). Training Principles For Adventure Sports. In *Adventure Sports Coaching* (pp. 189-207). Routledge.

Kim, D.W., & Koh, S.E. (2017). Effects of Ai Chi exercise on balance in patients with Parkinson's disease: A randomized crossover trial. Journal of Physical Therapy Science, 29(7), 1186-1189.

Ku, P.H., Chen, S.F., Yang, Y.R., Lai, T.C., & Wang, R.Y. (2020). The effects of Ai Chi for balance in individuals with chronic stroke: a randomized controlled trial. Scientific Reports, 10(1), 1201.

Kurt, E. E., Büyükturan, B., Büyükturan, Ö., Erdem, H. R., & Tuncay, F. (2018). Effects of Ai Chi on balance, quality of life, functional mobility, and motor impairment in patients with Parkinson's disease. Disability and Rehabilitation, 40(7), 791-797.

Küçük, H., Söyler, M., & Şahin, F. N. (2024). Relationship between burpee test and body composition: A sample of female university students. *SPORMETRE Beden Eğitimi Ve Spor Bilimleri Dergisi, 22*(1), 138-153. https://doi.org/10.33689/spormetre.1417860

Korkmaz, A. S., Kutluer, G., Hepsert, S., & Kiliç, Y. (2023). Gebelerde kinezyofobinin yaşam kalitesi ve düşme korkusu ile ilişkisinin incelenmesi. SPORMETRE Beden Eğitimi ve Spor Bilimleri Dergisi, 21(100. Yıl Özel Sayısı), 132-140.

Lauche, R., Stumpe, C., Fehr, J., Cramer, H., Cheng, Y. W., Wayne, P. M., ... & Dobos, G. (2016). The effects of tai chi and neck exercises in the treatment of chronic nonspecific neck pain: a randomized controlled trial. *The Journal of Pain, 17*(9), 1013-1027.

Li, F., Harmer, P., Fisher, K. J., & McAuley, E. (2004). Tai Chi: improving functional balance and predicting subsequent falls in older persons. Medicine & Science in Sports & Exercise, 36(12), 2046-2052.

Liu, H., & Frank, A. (2010). Tai chi as a balance improvement exercise for older adults: a systematic review. Journal of Geriatric Physical Therapy, 33(3), 103-109.

Liu, K., Ji, L., & Lu, Y. (2024). Influence of amputation on kinetic chain musculature activity during basic and modified core exercises. International Journal of Sports Physiology and Performance, 1(aop), 1-9.

Özsoy, G. (2019) Non-spesifik bel ağrısı olan yaşlı bireylerde corestabilizasyon eğitimleri ile birlikte uygulanan miyofasyal gevşetme tekniğinin ağrı, spinal mobilite, denge, yürüme ve fiziksel aktivite üzerine etkileri (Doktora Tezi, Dokuz Eylül Üniversitesi).

Pérez-de la Cruz, S. (2020). Comparison of aquatic therapy vs. dry land therapy to improve mobility of chronic stroke patients. International Journal of Environmental Research and Public Health, 17(13), 4728.

Pérez-de la Cruz, S. (2021). Comparison between three therapeutic options for the treatment of balance and gait in stroke: a randomized controlled trial. International Journal of Environmental Research and Public Health, 18(2), 426.

Sattin, R. W., Easley, K. A., Wolf, S. L., Chen, Y., & Kutner, M. H. (2005). Reduction in fear of falling through intense tai chi exercise training in older, transitionally frail adults. Journal of the American Geriatrics Society, 53(7), 1168-1178.

Shou, X. L., Wang, L., Jin, X. Q., Zhu, L. Y., Ren, A. H., & Wang, Q. N. (2019). Effect of T'ai Chi exercise on hypertension in young and middle-aged in-service staff. The Journal of Alternative and Complementary Medicine, 25(1), 73-78.

Sun, M., Min, L., Xu, N., Huang, L., & Li, X. (2021). The effect of exercise intervention on reducing the fall risk in older adults: a meta-analysis of randomized controlled trials. International Journal of Environmental Research and Public Health, 18(23), 12562.

Stevens, J. A., Corso, P. S., Finkelstein, E. A., & Miller, T. R. (2006). The costs of fatal and non-fatal falls among older adults. Injury Prevention, 12(5), 290-295.

Şahin, F., Büyükavcı, R., Sağ, S., Doğu, B., & Kuran, B. (2013). Berg denge ölçeği'nin Türkçe versiyonunun inmeli hastalarda geçerlilik ve güvenilirliği. Journal of Physical Medicine & Rehabilitation Sciences, 16(3), 170-175.

Teng, Y., Luo, W., Zhou, J., Wang, M., Wu, J., Nie, X., & Li, Z. (2024). Clinical research on tai chi: a review of health benefits. Acupuncture and Herbal Medicine, 10, 1097.

Taylor-Piliae, R. E., Newell, K. A., Cherin, R., Lee, M. J., King, A. C., & Haskell, W. L. (2010). Effects of Tai Chi and Western exercise on physical and cognitive functioning in healthy community-dwelling older adults. *Journal of aging and physical activity, 18*(3), 261-279.

Türkmen, İ., & Çağlar, E. Ç. (2023). Effects of aquatic and step aerobic exercises on flexibility parameters in sedentary women. Revista de Gestão e Secretariado, 14(10), 17633-17645.

Yılmaz, M. (2023). Kadın futbolcularda denge ve core stabilizasyon egzersizlerinin propriosepsiyon ve gövde enduransı üzerine etkilerinin karşılaştırılmas (Yüksek Lisans Tezi, İstanbul Gelişim Üniversitesi).

Jakobsen, T. L., Christensen, M., Christensen, S. S., Olsen, M., & Bandholm, T. (2010). Reliability of knee joint range of motion and circumference measurements after total knee arthroplasty: does tester experience matter?. *Physiotherapy Research International, 15*(3), 126-134.

Norton, K. I. (2018). Standards for anthropometry assessment. In *Kinanthropometry and exercise physiology (pp. 68-137). Routledge.*