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The Effect of Traditional and Suspension Strength Training on Motor Skill Development in Regular Exercisers

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DOI: https://doi.org/10.38021asbid.1565573 **ORIGINAL ARTICLE**

Geri Çekilme Nedeni: Makalenin "Veri Toplama" kısmında kullanılan cihazın kalibrasyonunda ve ölçümün hesaplanmasında kullanılan formülde bir hata tespit edilmiştir. Veriler ham verilerden analiz edilerek hesaplanır. Burada yer alan formülün yanlış hesaplanması nedeniyle veri seti hatalı oluşturulmuştur. Verilerin hatalı girilmesi sonucu verilerin analiz kısmını da etkilemiş olabilir. Bu hatalar, çalışmanın genel sonuçlarını geçersiz kılmakta olup, doğru ve güvenilir bilimsel sonuçlar elde etmek adına bu verilerin yeniden gözden geçirilmesi gerekmektedir.

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Abstract

The aim of this study was to investigate the effects of conventional and suspension strength training on selected motoric skills in individuals who regularly exercise. A total of 30 male volunteers with a mean age of 36.53±3.01 years participated in the study. The participants were divided into two groups as traditional strength group (TSG, n=15) and suspension strength group (SSG, n=15). Height, body weight, body mass index (BMI), push-up test, crunch test, plank, active jump (CMJ), y-balance and one repetition maximum (1RM) strength tests (bench press and squat) were performed before and after two different 8-week strength training programmes. The data were analysed using SPSS 26 package programme. After the normality assumption test, since the data showed normal distribution, Paired Samples T Test was used in the comparison of within the groups. As a result of the analysis, a statistically significant difference was found in the SSG pre-post test data in body weight, BMI, push-ups, crunch, plank, balance and 1TM bench press and squat values (p>0.05). A statistically significant difference was found in the TSG pre-post test data in body weight, BMI, push-ups, crunch, CMJ, 1TM bench press and squat values (p>0.05). In the posttest comparison between the groups, a significant difference was observed only in the plank test (p>0.05). As a result of the study, it was determined that strength exercises performed on unstable surfaces (push-ups, squats and crunch) showed more improvement than traditional strength training, although not statistically significant. We can say that suspensory strength training is effective in plank performance.

Keywords: Conventional Strength, Suspension Strength, Male.

Düzenli Egzersiz Yapan Bireylerde Geleneksel ve Süspansiyon Kuvvet Antrenmanlarının Seçilmiş Motorik Becerilere Etkisi

Öz

Bu çalışma, düzenli egzersiz yapan bireylerde geleneksel ve süspansiyon kuvvet antrenmanlarının seçili motorik becerileri üzerine etkisini incelemek amacıyla yapılmıştır. Çalışmaya yaş ortalamaları 36.53±3.01 olan toplam 30 erkek gönüllü olarak katılmıştır. Katılımcılar geleneksel kuvvet grubu (TSG, n=15) ve süspansiyon kuvvet grubu (SSG, n=15) olarak ikiye ayrılmıştır. Katılımcılara 8 haftalık iki farklı kuvvet antrenmanı öncesi ve sonrası boy uzunluğu, vücut ağırlığı, vücut kitle indeksi (VKI) şınav testi, mekik testi, plank, aktif sıçrama (CMJ), y-denge ve bir tekrar maksimum (1TM) kuvvet testleri (bench press ve skuat) uygulanmıştır. Veriler SPSS 26 paket program kullanılarak yapılmıştır. Normallik varsayım testinden sonra veriler normal dağılım gösterdiği için bağımlı iki grup karşılaştırmasında Paired Samples T Testi kullanılmıştır. Analizler sonucunda SSG ön-son test verilerinde; vücut ağırlığı, VKI, şınav, mekik, plank, denge ve 1TM bench press ve skuat değerlerinde istatiksel olarak anlamlı bir farklılık tespit edilmiştir (p>0,05). TSG ön-son test verilerinde; vücut ağırlığı, VKİ, şınav, mekik, CMJ, 1TM bench press ve skuat değerlerinde istatiksel olarak anlamlı bir farklılık tespit edilmiştir (p>0,05). Gruplar arası son test karşılaştırmasında ise sadece plank testinde anlamlı farklılık görülmüştür (p>0,05). Çalışma sonucunda sabit olmayan yüzeylerde yapılan kuvvet egzersizlerinin (şınav, squat ve mekik) geleneksel kuvvet antrenmanlarına göre istatistiksel olarak anlamlı olmasa da daha fazla gelişim gösterdiği tespit edilmiştir. Plank performansında ise süspansiyan kuvvet antrenmanların etkili olduğunu söyleyebiliriz.

Anahtar kelimeler: Geleneksel Kuvvet, Süspansiyon Kuvvet, Erkek.

Introduction

Today, physical activity and exercise are among the indispensable elements of a healthy life. Exercise is a frequently used method for individuals to improve their physical and mental health, increase their performance and improve their quality of life (Bojarczuk et al., 2019; Simioni et al., 2018). Studies provide important findings on how different types of exercise affect physiological, psychological and motoric skills in different age groups (Levin et al., 2017; Lorås et al., 2020; Azar et al., 2023). In this context, different types of exercises and training methods are preferred in line with the needs and goals of individuals. Strength and endurance training are among the widely preferred methods to increase the physical performance of individuals, improve muscle strength and improve general health. Among these trainings, traditional strength training (TST) and suspension training (ST), which have gained popularity in recent years, stand out as two basic methods that have the potential to provide effective muscle development and motoric performance increase (Tutar and Çelik, 2024; Ma et al., 2017; Aguilera-Castells et al., 2018).

Traditional strength training has been widely used by athletes and exercising individuals for many years and has been shown to increase muscular strength, overall performance (Guerriero et al., 2018) and have a positive effect on skeletal muscle endurance and improve dynamic balance (Azeem, and Zemková, 2022). While traditional training methods usually involve exercises with free weights or machines, suspension strength training, which has emerged in recent years, aims to improve balance, coordination and stabilisation skills through exercises using equipment such as body weight or ropes (Mohamed, 2016). It can be said that suspension strength training is an exercise that aims to be effective on the whole body, especially targeting the central muscles. This training method improves the functional movement abilities of individuals and has a more dynamic and challenging structure compared to traditional training (Angleri et al., 2020; Aguilera-Castells et al., 2018). This situation makes it important to investigate the effects of different training methods on motoric skills. These two different methods offer different effects on the development of motoric skills such as muscle strength, balance, coordination and flexibility and can be preferred according to the performance requirements of individuals. In previous studies, the effects of different strength training have been investigated in the elderly, elementary school-aged and sedentary individuals (Ma et al., 2017; Soligon et al., 2020; Marta et al., 2019; Tutar and Çelik, 2024; Marta et al., 2021). However, there are limited number of studies on the effects of different strength training on motoric performances in individuals who exercise regularly.

Therefore, the aim of this study was to comparatively examine the effects of traditional and suspension strength training on selected motoric skills in regular exercisers for 8 weeks. In this direction, the effects of both training types on motoric skills such as muscle strength and balance will

be evaluated in detail. It is aimed that the findings obtained from the study will contribute to the shaping of exercise programmes according to the needs of individuals and guide professionals working in the fields of sports and health.

Materials and Methods

Model of the Research

Before starting the exercises, height, body weight, BMI, Y-balance, plank, crunch test, push-up and active vertical jump (CMJ) tests were taken in the morning session and single repetition maximal strength tests were taken in the afternoon. Participants were divided into two groups by randomisation. One group performed suspension strength training (SSG) and the other group performed conventional strength training (TSG) for 8 weeks. After 8 weeks, height, body weight, BMI, Y-balance, plank, crunch test, push-up and active vertical jump (CMJ) tests and single repetition maximal strength tests were taken.

Population and Sample

The participants were 30 male volunteers aged between 30-40 years, following resistance training programmes regularly for at least 1 year, not having any cardiovascular disease, blood disease, chronic disease or joint injury in the last 1 year, not consuming alcohol and smoking. Participants were instructed to consume food at least 2 hours prior to the tests. Participants were divided into 2 groups of 15 participants each, suspension strength group (SSG) and traditional strength group (TSG), by simple random sampling method.

Data Collection Tools

Height-Body Weight Measurement

The height of the participants was measured in m with a wall-mounted stadiometer (Holtain, UK) with a precision of 0.1 cm in the anatomical posture, barefoot, with the feet fully on the ground, heels together and in contact with the wall, with reference to the point of contact on the height meter table. Body weights were measured with a digital scale (Seca, Vogel and Halke, Hamburg) with an accuracy of 0.1 kg in light sportswear consisting of shorts and t-shirt, barefoot and in anatomical posture. The body mass index (BMI) of the individuals was calculated by dividing the body weight in kilograms by the square of the height in metres (m^2).

Y Balance Test

In the ‘Y Balance Test’, which evaluates dynamic postural control, there were marks in centimetres on a ‘Y’ shaped pattern drawn on the floor. During the test, the participants were asked

to hold their hands at waist level, keep their heels steady on the floor and lightly touch the farthest point with the reaching foot. The measurements were made by the athletes' barefoot movements in the anterior (ANT), posterolateral (PL) and posteromedial (PM) directions, repeated three times. Measurements were repeated when errors such as athletes transferring body weight to the reaching foot, lifting the heel of the stance foot, or separating the hands from the hips were noticed (Enquist et al., 2015). The leg length of each participant is recorded by measuring the distance from the anterior superioriliac point to the distal part of the medial malleolus bilaterally in the supine position.' All reaching distances are recorded in centimetres and once the data are obtained, the distances obtained in each direction are normalised using the formula 'Best Reach Distance/Leg Length × 100 = % Most Reach Distance' to remove the effect of leg length (Gribble and Hertel, 2004).

Core Plank Test

The participant assumed a plank position on the elbows and feet parallel to the floor in a prone position. In this position, he/she maintained balance with the heels and head in a straight line. The participant was warned if he/she disturbed the position (hip dropping down or lifting up). The test of the athlete who received three warnings was terminated. The time the participant stayed in the plank position was recorded in seconds (Boyacı et al, 2018).

Vertical Jump Test (Counter Movement Jump/CMJ)

Participants were on the Optojump™ system (Microgate, Bolzano, Italy) with hands on waist, feet out to the side and upright. When the participants were ready, they completed the test by jumping upwards to the highest point. The measurement was repeated twice, and the best degree was recorded (Kale et al., 2023).

Maximal Strength Test (1RM)

Participants voluntarily determined their starting weights before starting the full squat and bench press test. Participants were specifically advised to start with 30-40% of their body weight when starting the RM test. In this way, muscle injuries that may occur during the RM test were prevented. The squat test was performed with a free barbell. The free squat movement was performed with weights determined by the participants. Strength values were obtained by increasing the weight they lifted and the degree of difficulty they felt by 5-7.5 kg. In the bench press movement, strength values were obtained by increasing the weight they lifted and the degree of difficulty they felt by 2-2.5 kg. The weight increase was continued until the participants could not do even one repetition, and the test was terminated when the participants stated that they could not continue. All tests were measured and recorded in kg (Suchomel et al., 2021).

Push-up Test (60 sec)

Participants stand in a prone position with arms shoulder-width apart, supported by their toes and palms; the body forms a straight line by keeping the hips up, then they bend their arms and slowly lower their body down and return to the starting position. The number of times they did the movement in 1 minute was determined and noted as a number (Alagesan et al., 2012).

Crunch Test (60 sec)

Participants assumed a supine position with the knees bent and the soles of the feet touching the floor; hands were placed at the sides of the head. The head was lifted slightly upwards and the chin was pulled towards the chest, this was done to avoid overstretching the neck muscles. Using the abdominal muscles, they completed the crunch by inhaling and lifting the shoulders up, slowly lifting the back off the floor and pulling the head and chest up. The number of crunch performed at maximum repetition for one minute was recorded (Alagesan et al., 2012).

Applied Training Programme

Before starting the training, the participants were reminded of the training program protocol. Each participant completed a standard warm-up phase. After the warm-up, the preparation phase was applied. With the completion of the preparation phase, the participants performed the training protocol specific to their groups in the main phase. The training ended with the cooling phase (Tutar, and Çelik, 2024). For the warm-up phase, light jogging on a treadmill (Lifefitness, USA) at a speed of 6 km.sec-1 for 5 min, 6 dynamic stretching movements based on large muscle groups with 4 repetitions each for weight lifting preparation, 2 sets of jack knife and superman movements with 10 repetitions as preparation for training lifts were performed. For the cooling phase, 10 static stretching movements, each lasting 6-8 seconds, involving large muscle groups, were performed while standing.

For the SSG group: In this group, participants do a functional resistance training using TRX and kettlebells to increase balance, coordination, flexibility and endurance. The Goblet Squat in the program develops lower body strength, while the Kettlebell Swing increases explosive power. The TRX Chest Press and TRX Rowing support upper body strength, while the TRX Single Leg Squat provides single leg balance. The TRX Front Plank strengthens core stabilization, and the TRX Cross Side Lunge increases lower body endurance. This program focuses on developing overall strength and balance with bodyweight movements (Zuo et al., 2022; Janot et al., 2013; Weiß et al., 2010).

For the TSG group: In this group, participants aim to develop muscle and gain pure strength through traditional strength movements performed with free weights. Back Squat increases lower

body strength, while Deadlift increases total body strength. Bench Press supports chest and upper body strength, while Lunge and Rowing develop muscle balance. Single Leg Squat, Plank and Cross Side Lunge are aimed at increasing core stabilization and lower body endurance. This program focuses on developing muscle mass and balance through classic strength training (Latella et al., 2022; Costa et al., 2021).

Table 1

SSG Protocol Table

MOVEMENTS	REPETITION	NUMBER OF SETS	TEMPO	INTENSITY	REST
GOBLET SQUAT	12	3	2-0-2	%70-85	60 seconds
KETTLEBELL SWING	12	3			
TRX CHEST PRESS	12	3			
KETTLEBELL STEP UP	12	3			
TRX ROWING	12	3			
TRX SINGLE LEG SQUAT	12	3			
TRX FRONT PLANK	30 seconds	3			
TRX CROSS SIDE LUNGE	12	3			

Table 2

Table of the TSG Protocol

MOVEMENTS	REPETITION	NUMBER OF SETS	TEMPO	INTENSITY	REST
BACK SQUAT	12	3	2-0-2	%70-85	60 seconds
DEADLIFT	12	3			
BENCH PRESS	12	3			
LUNGE	12	3			
ROWING	12	3			
SINGLE LEG SQUAT	12	3			
PLANK	30 seconds	3			
CROSS SIDE LUNGE	12	3			

Analysis of Data

All data were recorded and analyzed using the SPSS (Statistical Package for the Social Sciences) version 26 software. Initially, the necessary assumptions for determining the appropriate statistical tests (parametric or nonparametric) were assessed. The Shapiro-Wilk test was employed to evaluate the normality of the distribution, and the skewness and kurtosis coefficients were verified to fall within the range of ±1. For the comparison of two dependent groups with normally distributed data, the Paired Samples T Test was utilized. A significance level of 0.05 was set as the criterion for determining the statistical significance of the results.

Ethics of Research

All participants were informed in detail about the purpose and importance of the study, possible risks and the right to withdraw from the study at any time in accordance with the Declaration of Helsinki, and a consent form was filled out and signed. Nisantasi University Ethics Committee approval was obtained (No 2023/26). During the current research, 'Higher Education Institutions Scientific Research and Publication Ethics Directive' was followed.'

Results

Table 3

Age, Height and Body Weight Averages of Traditional Strength Group

Parameters	n	Mean	SD
Age (year)	15	35,27	3,01
Height (cm)	15	171.2	5,50
Body Weight (kg)	15	80,11	11,03

SD: standard deviation

When Table 3. was analysed, it was found that the mean age of the 15 participants was 35.27±3.01 years, body weight was 80.11±11.03 kg and height was 171.19±5.51 cm.

Table 4

Mean Age, Height and Body Weight of Suspension Strength Group

Parameters	n	Mean	SD
Age (year)	15	36,53	2,67
Height (cm)	15	163,3	7,32
Body Weight (kg)	15	68,85	11,50

SD: standard deviation

When Table 4 was analysed, it was found that the suspension strength group of the participants was 36.53±2.67 years, body weight was 68.85±11.50 kg and height was 163.27±7.32 cm.

Table 5
Traditional Strength Group Pre-Post Test Analysis

Parameters	n	X±SD (pre-test)	X±SD (post-test)	t	p	ES
Body Weight (kg)	15	80,11±11,03	78,27±11,02	10,10	**,000**	2,61
Body Mass Index(BMI)	15	27,57±3,45	26,82±3,49	7,30	**,000**	2,54
Push-up (pcs)	15	21,27±4,45	26,13±5,24	-5,92	**,000**	1,89
Crunch (pcs)	15	27,27±6,94	30,80±5,48	-4,13	**,001**	1,83
Plank (sec)	15	99,53±15,98	99,80±16,08	-0,15	,880	-1,53
CMJ (cm)	15	40,98±4,89	39,86±4,95	2,21	**,045**	-1,49
Balance (Right Foot)(cm)	15	82,30±5,93	82,24±5,93	0,29	,780	-1,07
Balance (Left Foot) (cm)	15	82,26±7,30	82,24±7,19	0,15	,886	-1,04
Bench 1RM	15	59,80±6,27	64,80±8,12	-8,10	**,000**	-0,04
Squat 1RM	15	93,20±6,89	104,13±9,61	-10,52	**,000**	-0,04

X±SD: Mean±standard deviation, **ES**: effect size, **CMJ:** counter movement jump

When Table 5. is analysed, no statistically significant difference was found in plank, balance right and left foot parameters in the traditional strength group. A statistically significant difference was found in body weight BMI, push-up, crunch, CMJ, bench press and squat 1RM values. The significant difference in the CMJ value is seen to be lower jump height in the post-test compared to the pre-test value.

Table 6
Suspension Strength Group Pre-Post Test Analysis

Parameters	n	X±SD (pre-test)	X±SD (post-test)	t	p	ES
Body Weight (kg)	15	68,85±11,50	66,78±11,14	4,59	**,000**	0,57
Body Mass Index(BMI)	15	26,21±5,25	25,66±5,28	8,11	**,000**	0,55
Push-up (pcs)	15	24,07±4,25	30,87±4,93	-5,80	**,000**	0,07
Crunch (pcs)	15	25,00±5,32	38,00±5,67	-7,67	**,000**	0,07
Plank (sec)	15	103,87±23,15	112,53±23,76	-6,30	**,000**	0,04
CMJ (cm)	15	38,05±4,16	38,82±6,78	-0,67	,513	0,04
Balance (Right Foot) (cm)	15	86,12±5,76	87,52±5,75	-6,37	**,000**	-2,09
Balance (Left Foot) (cm)	15	88,28±6,43	89,51±6,25	-4,07	**,001**	-2,04
Bench 1RM	15	56,80±6,74	60,00±8,71	-4,77	**,000**	-2,72
Squat 1RM	15	88,33±6,13	93,87±8,98	-4,18	**,001**	-2,64

X±SD: Mean±standard deviation, **ES**: effect size, **CMJ:** counter movement jump

When Table 6. is analysed, there was no statistically significant difference in CMJ parameter in the traditional strength group. A statistically significant difference was found in body weight BMI, push-up, crunch, plank, balance right and left foot, bench press and squat 1RM values.

Table 7

Pre-test Analysis Between Groups

Parameters	n	TSG X±SD (Pre-test)	SSG X±SD (Pre-test)	t	p
Body Weight (kg)	15	80,11±11,03	68,85±11,50	,037	,849
Body Mass Index(BMI)	15	27,57±3,45	26,21±5,25	4,365	**,046**
Push-up (pcs)	15	21,27±4,45	26,13±5,24	,000	,993
Crunch (pcs)	15	27,27±6,94	24,07±4,25	1,181	,286
Plank (sec)	15	99,53±15,98	99,80±16,08	2,525	,123
CMJ (cm)	15	40,98±4,89	39,86±4,95	,037	,848
Balance (Right Foot) (cm)	15	82,30±5,93	86,12±5,76	,083	,775
Balance (Left Foot) (cm)	15	82,26±7,30	88,28±6,43	,342	,563
Bench 1RM	15	59,80±6,27	56,80±6,74	,954	,337
Squat 1RM	15	93,20±6,89	88,33±6,13	,010	,923

X±SD: Mean±standard deviation**, TSG:** traditional strength group, **SSG:** suspension strength group, **CMJ:** counter movement jump

When Table 7. was analysed, a statistically significant difference was observed in body mass index in the pre-test data of traditional strength and suspension strength groups.

Table 8

Posttest Analysis Between Groups

Parameters	n	TSG X±SD (Post test)	SSG X±SD (Post test)	t	p
Body Weight (kg)	15	78,27±11,02	66,78±11,14	,025	,875
Body Mass Index(BMI)	15	26,82±3,49	25,66±5,28	4,075	,053
Push-up(pcs)	15	26,13±5,24	30,87±4,93	,064	,802
Crunch (pcs)	15	30,80±5,48	38,00±5,67	,005	,944
Plank (sec)	15	99,80±16,08	112,53±23,76	5,206	**,030**
CMJ (cm)	15	39,86±4,95	38,82±6,78	,547	,466
Balance (Right Foot) (cm)	15	82,24±5,93	87,52±5,75	,044	,835
Balance (Left Foot) (cm)	15	82,24±7,19	89,51±6,25	,353	,557
Bench 1RM	15	64,80±8,12	60,00±8,71	,317	,578
Squat 1RM	15	104,13±9,61	93,87±8,98	,101	,753

X±SD: Mean±standard deviation**, TSG:** traditional strength group, **SSG:** suspension strength group, **CMJ:** counter movement jump, **TSG:** traditional strength group,

When Table 8. is analysed, a statistically significant difference was observed in the plank movement in the post-test data of the traditional strength and suspension strength groups.

Discussion and Conclusion, Suggestions

The aim of this study was to determine the effects of 8-week suspension and traditional strength training on selected motoric skills in individuals who regularly exercise.

When the groups were evaluated within themselves, the group performing traditional strength training (TST) showed a decrease in body weight and BMI after training, and an increase in push-up, crunch, bench press, and squat 1RM values. A decrease was observed in CMJ, while there was no

significant difference in plank and balance values. A study conducted on elderly male individuals also reported that TST increased muscle strength but had less pronounced effects on balance abilities (Granacher et al., 2011).

Traditional strength training enhances motor performance through a combination of neural and muscular adaptations. Early strength gains are primarily driven by neural mechanisms, including increased corticospinal excitability, improved motor unit recruitment, and enhanced inter-muscular coordination. These neural adaptations are crucial for the initial improvements in strength and motor performance, while long-term gains also involve muscular changes (Selvanayagam et al., 2011; Tallent et al., 2021; Vecchio et al., 2019; Duchateau et al., 2006). Differences in study results may stem from factors such as the age group of the population applied, prior strength training experience, or variations in training content.

In the group performing suspension strength training (SST), a decrease in body weight and BMI, and an increase in push-up, crunch, plank, balance, 1RM bench press, and squat values were observed. No significant difference was found in CMJ. In a study conducted on young judo athletes, an improvement in jump and balance performance was observed after 5 weeks of suspension training (Norambuena et al., 2021). Megahed and Tarek (2023) reported that suspension training is more effective in improving dynamic balance than free weight training. Suspension training (ST) is a type of resistance exercise where certain parts of the body (e.g., arms or legs) are attached to hanging straps. This method allows for versatile and multi-joint exercises in an unstable environment using body weight and gravity (Mok et al., 2015; Angleri et al., 2020). Therefore, the improvement in balance in the suspension training group may be attributed to this.

When groups were compared, a significant difference was found in plank time in favor of the SST ($t=5.206$, $p=0.030$). The significant improvement in plank time in the SST indicates that suspension training has positive effects on body stability and core muscle endurance. This type of training, performed on an unstable surface, may contribute to greater activation of core muscles. Literature supports that suspension training provides positive adaptations in exercises that require body stability and core endurance (Sevinç Yılmaz, 2021; Giancotti et al., 2018). A study conducted on elderly male individuals (64 ± 3 years) found that ST improved muscle mass, strength, and functional performance similar to TST (Soligon et al., 2020). Although there is an age difference, our study also found an increase in muscle strength in both groups after exercise.

Similar to our study, Arazi et al., (2018) reported in their study that both TST and ST would lead to improvements in muscle strength and endurance. However, contrary to our results, they stated that ST training would show more gains in upper body strength and endurance compared to traditional

training. Another study reported that suspension ST showed greater improvement in lower body muscle strength and balance compared to traditional strength training (Tutar and Çelik, 2024).

On the other hand, no statistically significant difference was found in body weight (kg), body mass index (BMI), number of push-ups and crunch, plank time, and right and left foot balance results ($p>0.05$). This suggests that traditional and suspension training may have similar effects on these parameters. It was observed that both groups improved in terms of strength and endurance development. However, there is no specific superiority between the groups.

Finally, no significant difference was found in bench press and squat 1 repetition maximum (1RM) values. Although traditional strength training may be advantageous for maximal strength development, it was also observed that suspension training provides similar strength adaptations. These results indicate that while both training types facilitate strength development, they may create differences in specific strength adaptations.

In a study, it was stated that suspension push-ups would cause more oxygen consumption compared to traditional bench press exercises, but would provide an equivalent reduction in muscle strength compared to isotonic exercise (Bellar et al., 2018). Kohiruimaki, et al. (2019) stated that suspended push-up training can increase muscle size in both upper extremities and abdominal muscles, but does not improve maximum strength after training. In our findings, although not statistically significant, the push-up averages of SSG were higher than those of TSG.

It was observed that strength exercises (push-ups, squats, crunch, and planks) performed on unstable surfaces showed greater improvement compared to traditional strength training, although this difference was not statistically significant. difference may be thought to be due to the fact that the movements of SKG were performed in a suspended state, in different planes and in accordance with the multi-joint principle. Strength exercises performed on non-fixed surfaces are thought to affect the development of physical performance due to increased nervous system stimuli, activation of different muscle groups and more stimulation of receptors.

In addition to traditional strength training, strength exercises on non-fixed surfaces, especially in sedentary individuals, can be recommended with suspension equipment. In addition, suspension equipment can be recommended because it is accessible, can be used everywhere and is more attractive in terms of cost.

Ethics Committee Permission Information

Ethics review board: Nisantasi University- Scientific Research Ethics Committee

Date of ethical approval document: 04.01.2024

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Authors' contributions

The subject and planning of the research was carried out by the first, second and third author, the processes related to the method and findings were carried out by the second, third and fourth author, the collection of data was carried out by the first and sixth author, the processes related to statistics were carried out by the third, fourth and fifth author, the writing and control of the article were carried out by all authors, and the processes related to the discussion and conclusion were carried out by the second, fifth and sixth authors.

Conflicts of interest

The authors have no conflict declaration regarding the research.

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