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THE EFFECTS OF KINESIOLOGICAL TAPING AND AEROBIC EXERCISE IN WOMEN WITH PRIMARY DYSMENORRHEA: A RANDOMİZED SINGLE-BLIND CONTROLLED TRIAL

ABSTRACT

Purpose: This study aimed to investigate the effects of kinesiological taping (KT) and aerobic exercise (AE) on pain, menstrual attitude, depression, and quality of life (QoL) in women with primary dysmenorrhea (PD).

Methods: Forty-five participants diagnosed with PD were randomly assigned into three groups: KT group (n=15), AE group (n=15), and control group (n=15). The KT group received taping twice a week over 3 weeks, starting from the 14th day of the menstrual cycle until the end of the cycle. The AE group performed moderate-intensity AE for 45 minutes twice a week for 3 weeks, following the same schedule. The control group received no intervention. Participants were evaluated on the 14th day of the cycle and after 3 weeks using the McGill Pain Questionnaire (MPQ) for pain, the Menstrual Attitude Scale (MAS) for attitude, the Beck Depression Scale (BDS) for depression, and the short form-36 (SF-36) for QoL.

Results: Within-group analyses showed significant improvements in MAS and SF-36 in the KT group, and in MPQ in the AE group ($p<0.05$). No significant changes were observed in the control group ($p>0.05$). Time*Group interaction analysis revealed a significant improvement in MPQ favoring the AE group and in MAS favoring the KT group ($p<0.05$).

Conclusion: These findings suggest that KT may improve menstrual attitude, while AE may reduce pain in women with PD.

Keywords: Attitude, Dysmenorrhea, Exercise, Pain, Quality of life

PRİMER DİSMENORELİ KADINLARDA KİNEZYOLOJİK BANTLAMA VE AEROBİK EGZERSİZİN ETKİLERİ: RANDOMİZE TEK KÖR KONTROLLÜ ÇALIŞMA

ÖZ

Amaç: Bu çalışmanın amacı, primer dismenoreli (PD) kadınlarda kinesiyolojik bantlama (KT) ve aerobik egzersizin (AE) ağrı, menstrüasyona yönelik tutum, depresyon ve yaşam kalitesi (YK) üzerindeki etkilerini incelemektir.

Yöntem: Primer dismenore tanısı almış 45 katılımcı rastgele olarak KT grubu (n=15), AE grubu (n=15) ve kontrol grubu (n=15) olmak üzere üç gruba ayrıldı. KT grubuna menstrüel döngünün 14. gününden başlayarak döngü sonuna kadar haftada iki kez, 3 hafta boyunca KT uygulandı. AE grubuna aynı dönem boyunca haftada iki kez, 45 dakikalık orta şiddette AE uygulandı. Kontrol grubuna herhangi bir müdahale yapılmadı. Tüm katılımcılar ağrı için McGill Ağrı Anketi (MAA), tutum için Menstrüel Tutum Ölçeği (MTÖ), depresyon için Beck Depresyon Ölçeği (BDÖ) ve YK için kısa form-36 (SF-36) ile değerlendirildi. Değerlendirmeler menstrüel döngünün 14. gününde ve 3 hafta sonra yapıldı.

Bulgular: Grup içi değerlendirmelerde, KT grubunda MTÖ ve SF-36, AE grubunda MAA'da anlamlı iyileşme saptandı ($p<0,05$). Kontrol grubunda anlamlı fark görülmedi ($p>0,05$). Zaman*Grup etkileşim analizinde, AE grubunda MAA lehine ($p<0,05$), KT grubunda MTÖ lehine anlamlı fark bulundu ($p<0,05$).

Sonuç: Sonuçlar, PD kadınlarda KT'nin menstrüasyona yönelik tutumu iyileştirebileceğini, AE'nin ise ağrıyı azaltabileceğini göstermektedir.

Anahtar Kelimeler: Tutum, Dismenore, Egzersiz, Ağrı, Yaşam kalitesi

INTRODUCTION

Primary dysmenorrhea (PD) is a painful uterine contraction caused by endometrial laceration. Pain occurs in the abdomen and lumbar region, in the form of cramping and colic in PD. The pain begins a few days before menstruation and persists for 48 to 72 hours (1). The causes of PD are still unclear, but one of the most accepted explanations is increased synthesis of prostaglandins resulting in dysrhythmic uterine contractions and decreased blood flow (2). PD can cause a decrease in work efficiency, tension in social life, and school/work absences. Attitudes towards dysmenorrhea are affected by cultural, ethnic, and religious backgrounds (3). The mood also can affect the menstrual cycle (4). Depression, anxiety and stress levels, which seem to be associated with many types of pain, may increase the incidence of PD. Emotional and behavioral problems increase menstrual cycle problems and dysmenorrhea. The symptoms of dysmenorrhea can lead to decreased quality of life (QoL). The activities of daily living (ADL) are negatively affected due to unpleasant symptoms accompanying pain in PD (5).

Medications such as non-steroidal anti-inflammatory drugs and oral contraceptive pills rank among the most frequently used to treat PD via suppressing pain, reducing prostaglandin levels and increasing circulatory flow in the uterine tract (6). There are also non-pharmacological treatment methods such as exercise, heat pad, TENS and kinesiological taping (KT) applied to reduce pain for the treatment of PD (7).

Exercise recommended in menstruation and alleviates the effects of dysmenorrhea by reducing sympathetic system activity, affects the level of endorphin which is effective in reducing pain (8). Stress effectively causes contraction in the uterus. Exercise is helpful in reducing the symptoms during the menstrual cycle and changing the mood. In a review, the exercise was concluded to reduce symptoms in dysmenorrhoea (9). They also observed that people who exercised more than three times a week compared to sedentary patients had fewer symptoms during the menstrual period. Vaziri et al. (10), observed that aerobic exercises (AE) reduce pain in PD. Dehnavi et al. (9) concluded that moderate-intensity AE can reduce and prevent the appearance of symptoms in PD.

Kinesio Tape (KT) is an elastic therapeutic tape to microscopically lift the skin. KT inhibits pain by stimulating cutaneous mechanoreceptors and activates the soft tissue in the painful area. It also accelerates lymph and blood circulation by creating a gap between the muscle and fascia. It facilitates lymphatic drainage, relaxes the muscles in excessive contraction, and relieves pain. KT also slows the stimulation of pain receptors under the skin after this relaxation and increases in circulation and provides the advantage of acting painlessly. Lim et al. (11), found that KT was effective in reducing pain during menstruation. In another study, it was reported that KT and lifestyle changes can be used to improve QoL and body awareness and to relieve pain, and also KT is stated as an effective method in reducing pain, anxiety and some menstrual complaints in women with PD (12).

The purpose of this study was to investigate the effects of KT and AE on pain, attitude, depression, and QoL in women with PD.

METHOD

Study Design

This study was a randomized, controlled, and single blind (evaluator) trial, registered in ClinicalTrials.gov (NCT04856280). The study was approved by the İstanbul Medipol University Non-Invasive Clinical Research Ethics Committee (approval number: 10840098-604.01.01, date: 11.10.2019).

Participants

Participants were recruited among healthy young adults who had been diagnosed with PD by a gynecologist attending Üsküdar, İstanbul, Türkiye. This study was concluded between October 2019-March 2020.

Forty-five women with dysmenorrhea aged 15-30 years who fulfilled the inclusion criteria were included in the study. The sample size was determined using the G*Power sample size calculator (13). Sample size was calculated using "ANOVA: Repeated measures, within-between interaction design" with an 95% power (α=0.05, β=0.20) and effect size of 0.32 for a sample size of 42 participants.

Patients who met the inclusion criteria were included in the study. The inclusion criteria was defined as being aged between 15-30, having started the menstrual cycle and continuing the cycle, taking ≥5 points from Visual Analog Scale during the menstrual cycle. The exclusion criteria was defined as having endometriosis, adenomyosis, myoma uteri, and endometrial polyp, having a pelvic infection, using an intrauterine device, having venous congestion in the internal genital organs. All participants had signed a written informed consent form, and the study has been conducted in accordance with the principles of the Declaration of Helsinki. The participants were randomly divided into 3 groups using block randomization in Microsoft Excel "RAND(WS)" function as the KT group (n=15), the AE group (n=15) and the control group (n=15). At the beginning of the study, 45 participants were included in the study, but according to having an allergic reaction, one participant was excluded from the study. The study was completed with 44 participants. The allocation was shown in the flow chart diagram (Figure 1).

Outcome Measurements

All participants were evaluated in terms of sociodemographic and anthropometric datas, Mcgill Pain Questionnaire (MPQ), Menstrual Attitude Scale (MAS), Beck Depression Scale (BDS), and short form-36 (SF-36) 14th day of the menstrual cycle and 3 weeks later. None of the scales require permission.

Demographic Information Form: It was prepared to record the socio-demographic characteristics included in the study.

Pain: MPQ was used to evaluate pain. It consists of 11 words to determine the sensory state of pain, and 15 words related to the quality of pain in total, consisting of 4 different words to determine its affective aspect. In this scale, "0" is defined as no pain, "5" is defined as unbearable pain. The validity and reliability of the questionnaire in Turkish was concluded by Yakut et al. (14).

Attitude: MAS was used to evaluate attitude. It can be self-answered, easy to apply scale, and contains 33 items to measure the positive and negative attitudes of menstruation. The scale is of 5-point Likert type. The high average score of the subscales shows that the attitude towards menstruation is "positive". The validity and reliability of the questionnaire in Turkish was concluded by Kulakaç et al. (15).

Depression: BDS was used to evaluate depression. It is a self-evaluating test containing 21 items. It measures depression symptoms. The items determine a behavioral feature. Items are numbered from 0 to 3. Scoring: 0-9 points: Minimal depression; 10-16 points: Mild depression; 17-29 points: Moderate depression; 30-63 points: Severe depression. The validity and reliability of the questionnaire in Turkish was concluded by Hisli (16).

Quality of Life: SF-36 was used to evaluate QoL. It is a 36-question self-assessment scale. It is based on physical function (10 items), role limitations due to physical (4 items) and emotional problems (3 items), pain (2 items), vitality (4 items), social function (2 items), mental health (5 items) and general health (5 items) subscales. Each subscale is scored between 0-100 and "0" indicates the lowest and "100" shows the best QoL. The validity and reliability of the questionnaire in Turkish was concluded by Demiral et al. (17).

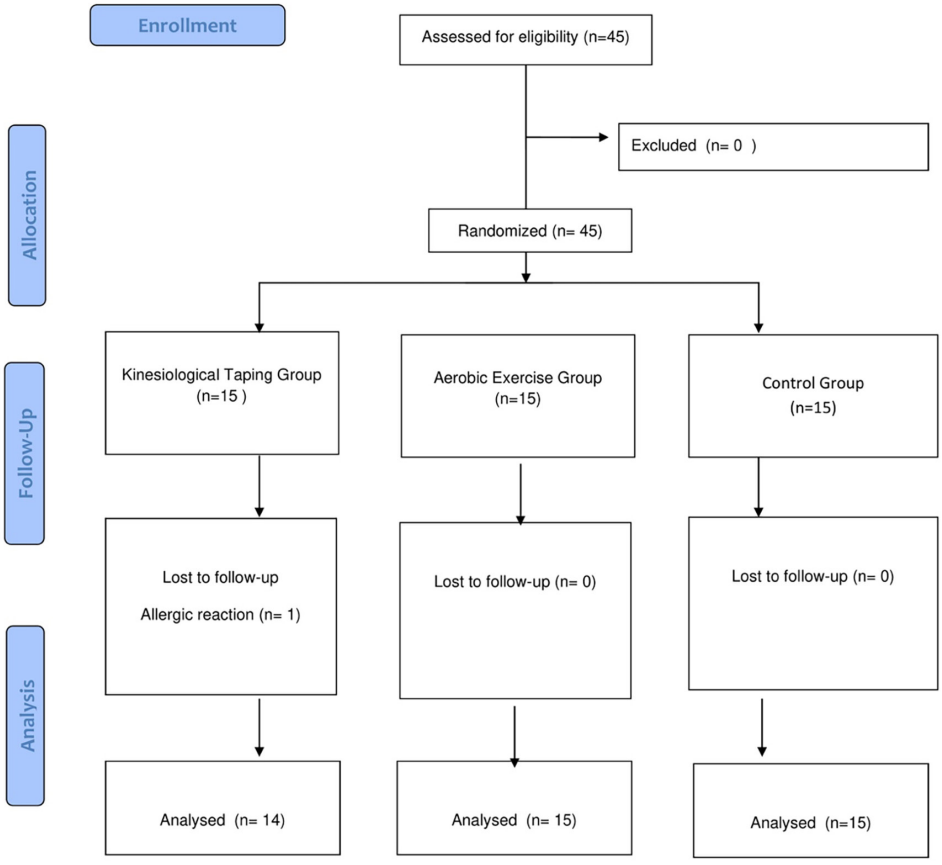

Figure 1. Flow chart.

Intervention Protocols

Participants in the KT group received KT twice a week over 3 weeks (total 6 sessions), starting from the 14th day of the menstrual cycle. Participants in the AE group received moderate-intensity AE 45 minute sessions, twice a week over 3 weeks (total 6 sessions), starting from the 14th day of the menstrual cycle. Participants in the control group received no application. Participants were asked not to use analgesics throughout the study and to continue their routine ADL but not doing physical exercise.

KT Protocol: Six sessions of taping were applied, starting on the 14th day of the menstrual cycle and 2 times a week for 3 weeks. Using the ligament technique, it was applied to the supra pubic region with 100% tension in order to reduce contraction in the uterus (Figures 2, 3).

AE Protocol: Moderate-intensity AE was received during the menstrual cycle, 45 minutes session per day, 3 days a week over 3 weeks. The exercise protocol consists of 5 minute warm up, 35 min AE and 5 minute cool-down exercises. Warm-up and cool-down exercises include an active range of motion (ROM) exercises for upper and lower extremities (Figure 4). The AE includes 35 min of moderate walking and climbing stairs was performed in accordance with the definition; "It was given to the participants that during moderate exercise, the individual should walk with a tempo in a way that he can speak but cannot sing" (18).

Statistical Analysis

IBM SPSS (Statistical Package for Social Science) version 25.0 was used for statistical analysis. Mean, standard deviation and percentage values were presented in the descriptive statistics of the data. The nominal data of the independent variables were evaluated with the chi-square test, and the numerical data were evaluated with the one-way ANOVA test. Time-dependent differences within groups two-way Repeated Measure ANOVA and Time*Group interactions between groups were analyzed by ANCOVA. Bonferroni correction was used for post-hoc analyses. The significance value was accepted as $p<0.05$.

RESULTS

Forty-four participants were included in the study. The mean age was 21.92±2.43 years in the KT group, 21.20±1.01 in the AE group and 24±1.73 in the control group. The minimum age was 19 and the maximum age was 28. The mean body mass index (BMI) was 2.32±3.23 in the KT group, 20.04±3.25 in the AE group and 22.01±2.89 in the control group. Length of menstrual period was 4.85±0.86 in the KT group, 4.93±0.70 in the AE group and 5.46±0.99 in the control group. Thirteen of 42 participants used analgesics once a month, 15 of them used twice a month, and 16 of them used three times a month. None of the participants used hormonal pills and had smoking habits and history of surgery. There was a significant difference in terms of age and education level between groups ($p<0.05$). There was no significant difference in terms of BMI, length of the menstrual period, use of analgesics and hormonal pills, smoking habits, and history of surgery between groups ($p>0.05$). The distribution of demographic data was shown in Table 1.

The findings within the KT group are shown in Table 2. Significant differences were found in terms of MAS, SF-36 physical and mental function in the KT group ($p<0.05$). The findings within the AE group are given in Table 3. A significant difference was found in terms of MPQ in the AE group ($p<0.05$).

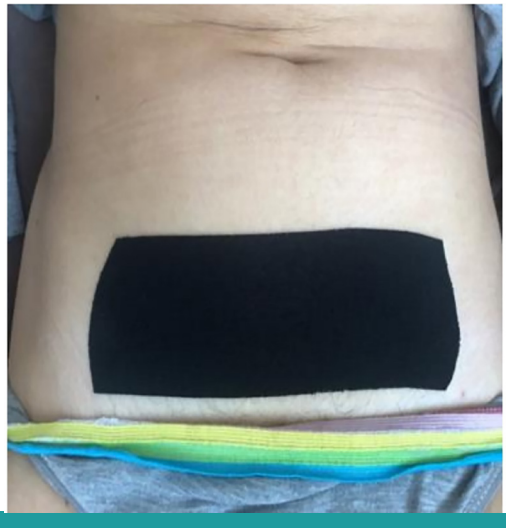

Figure 2. KT ligament technique.
KT: Kinesiological Taping.

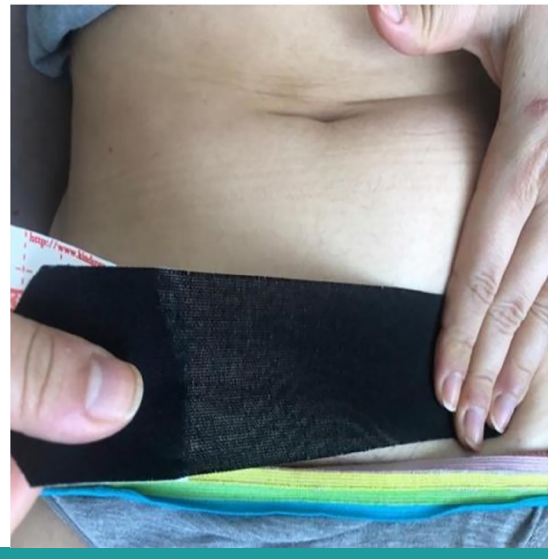

Figure 3. 100% tension.

Figure 4. Warm up and cool-down exercises.

The findings within the control group are given in Table 4. There was no significant difference in the control group (p>0.05).

The findings between groups are shown in Table 5. There was a significant difference between groups in pre-treatment evaluations in terms of SF-36- physical function in favor of the KT group (p<0.05). There were significant differences between groups in terms of MAS and SF-36 physical function in favor of the KT group (p<0.05). In Time*Group interaction analysis, there were significant differences in terms of MPQ and MAS (p<0.05).

Post-hoc findings in terms of MPQ and MAS are shown in Table 6, Figure 5. There was no significant difference in terms of MPQ in post-hoc analysis (p>0.05). There was a significant difference in terms of MAS between KT and control group in favor of KT group (p<0.05). There was a significant difference in terms of MAS between AE and control group in favor of AE group (p<0.05). There was no significant difference in terms of MAS between KT and AE group (p>0.05).

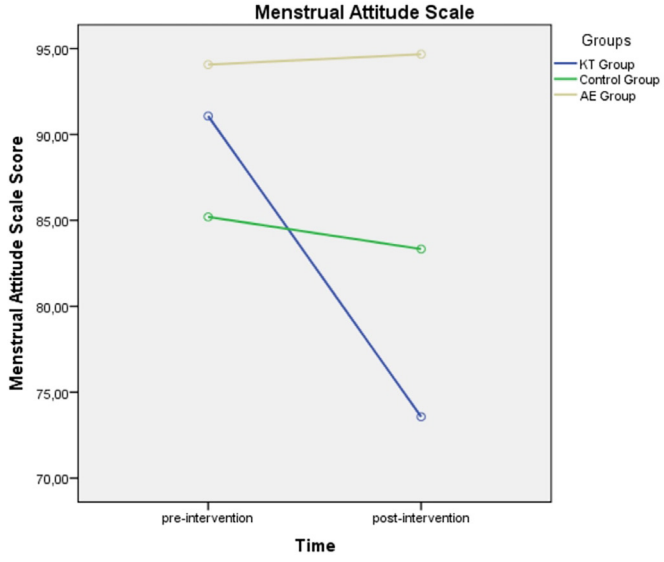

Figure 5. McGill Questionaire post-hoc analysis plot.
KT: Kinesiological Taping, AE: Aerobic Exercise.

Table 1. Distribution of demographic findings

		KT group (n=14)	AE group (n=15)	Control group (n=15)	F/X² value	p-value
		Avg ± SD	Avg ± SD	Avg ± SD		
Age (avg ± SD)		21.92±2.43	21.20±1.01	24±1.73	9.702	**0.000***
BMI (avg ± SD)		22.32±3.23	20.04±3.25	22.01±2.89	2.314	0.112
Length of menstrual period (avg ± SD)		4.85±0.86	4.93±0.70	5.46±0.99	3.111	0.124
Education level	**High-school (n/%)**	5/35.7	-	-	30.01	**0.000***
	University (n/%)	1/7.1	15/100	5/33.3		
	Not student (n/%)	8/57.1	-	10/66.7		

Table 1. Continued

		KT group (n=14)	AE group (n=15)	Control group (n=15)	F/X² value	p-value
		Avg ± SD	Avg ± SD	Avg ± SD		
Use of analgesics	Once a month (n / %)	2/14.3	5/33.3	6/40	7.582	0.108
	Twice a month (n / %)	3/21.4	7/46.7	5/33.3		
	Three times a month (n / %)	9/64.3	3/20	4/26.7		
Use of hormonal pills	Yes (n / %)	0/0	0/0	0/0	-	-
	No (n / %)	14/100	15/100	15/100		
Smoking habitus	Yes (n / %)	0/0	0/0	0/0	-	-
	No (n / %)	14/100	15/100	15/100		
History of surgery	Yes (n / %)	0/0	0/0	0/0	-	-
	No (n / %)	14/100	15/100	15/100		

KT: Kinesiological Taping, AE: Aerobic Exercise, BMI: Body Mass Index, Avg: Average, SD: Standard Deviation, *: p≤0.05.

Table 2. Within group findings in KT group

	Pre-treatment	Post-treatment	Mean difference	Confidence interval	F	Effect size (d)	p-value
	Avg ± SD	Avg ± SD		Lower to upper			
MPQ	29.42±11.05	26.92±10.01	2.500	-0.069 to 5.069	4.417	0.254	0.056
MAS	91.07±6.93	73.57±10.81	17.500	12.617 to 22.382	59.965	0.822	**0.000***
BDS	15.85±6.17	15.42±5.22	0.429	-1.40728 to 2.264	0.254	0.019	0.622
SF-36 - P	88.92±10.77	93.92±7.38	-5.000	-8.202 to -1.797	11.375	0.467	**0.005***
SF-36 - M	58.00±12.07	64.57±11.35	-6.571	-11.803 to -1.339	7.363	0.362	**0.018***

MPQ: McGill Pain Questionnaire, MAS: Menstrual Attitude Scale, BDS: Beck Depression Scale, SF-36 - P: Short-Form 36 - Physical Function, SF-36 - M: Short Form-36 Mental Function, KT: Kinesiological Taping, AE: Aerobic Exercise, Avg: Average, SD: Standard Deviation, *: p≤0.05.

Table 3. Within group findings in AE group

	Pre-treatment	Post-treatment	Mean difference	Confidence interval	F	Effect size (d)	p-value
	Avg ± SD	Avg ± SD		Lower to upper			
MPQ	37.13±14.71	16.10±16.50	20.533	10.745 to 30.321	20.244	0.591	**0.000***
MAS	94.06±15.02	94.06±15.17	-0.600	-4.695 to 3.495	0.099	0.007	0.758
BDS	19.53±10.63	17.26±13.56	2.267	-2.581 to 7.114	1.006	0.067	0.333
SF-36 - P	64.66±15.02	68.66±25.45	-4.000	-13.014 to 5.014	0.906	0.061	0.357
SF-36 - M	52.66±25.10	50.93±24.89	1.733	-3.943 to 7.409	0.429	0.030	0.523

MPQ: McGill Pain Questionnaire, MAS: Menstrual Attitude Scale, BDS: Beck Depression Scale, SF-36 - P: Short Form-36 - Physical Function, SF-36 - M: Short-Form 36 - Mental Function, KT: Kinesiological Taping, Avg: Average, SD: Standard Deviation, *: p≤0.05.

Table 4. Within group findings in control group

	Pre-treatment	Post-treatment	Mean difference	Confidence interval	F	Effect size (d)	p-value
	Avg ± SD	Avg ± SD		Lower to upper			
MPQ	26.73±9.96	26.33±10.35	0.400	-1.763 to 2.563	0.157	0.011	0.698
MAS	85.20±8.00	83.33±7.86	1.867	-0.405 to 4.139	3.104	0.181	0.100
BDS	15.73±6.32	19.53±7.31	-0.800	-2.076 to 0.476	1.806	0.114	0.200
SF-36 - P	84.00±19.92	82.66±14.74	1.333	-4.250 to 6.917	0.262	0.018	0.617
SF-36 - M	56.40±19.65	55.06±16.81	1.333	-2.110 to 4.776	0.690	0.047	0.420

MPQ: McGill Pain Questionnaire, MAS: Menstrual Attitude Scale, BDS: Beck Depression Scale, SF-36 - P: Short Form 36 - Physical Function, SF-36 - M: Short Form-36 Mental Function, KT: Kinesiological Taping, Avg: Average, SD: Standard Deviation, *: p≤0.05.

Table 5. Between group findings

	Pre-treatment				p-value	Post-treatment				p-value	Difference			
	KT group (n=14)		AE group (n=15)	Control group (n=15)		KT group (n=14)		AE group (n=15)	Control group (n=15)		MD	F	Effect size (d)	p-value
	Avg ± SD		Avg ± SD	Avg ± SD		Avg ± SD		Avg ± SD	Avg ± SD					
MPQ	29.42±11.05		37.13±14.71	26.73±9.96	0.062	29.62±10.01		16.60±16.50	26.33±10.35	0.057	7.811	15.427	0.429	**0.000***
MAS	91.07±6.93		94.06±15.02	85.20±8	0.081	73.52±10.81		94.66±15.17	83.33±7.86	**0.000***	6.256	29.316	0.588	**0.000***
BDS	15.85±6.17		19.53±10.63	15.73±6.32	0.351	15.42±5.22		17.26±13.56	16.53±7.31	0.872	0.632	1.145	0.053	0.328
SF36-P	88.92±10.77		64.66±28.81	84.00±19.92	**0.009***	93.92±7.38		68.66±25.45	82.66±14.74	**0.002***	-2.556	1.266	0.058	0.293
SF36-M	58.00±12.07		52.66±25.10	56.40±19.65	0.758	64.57±11.35		50.93±24.89	55.06±16.81	**0.146***	-1.168	4.182	0.169	0.022

MPQ: McGill Pain Questionnaire, MAS: Menstrual Attitude Scale, BDS: Beck Depression Scale, SF-36 - P: Short Form-36 - Physical Function, SF-36 - M: Short Form-36 Mental Function, KT: Kinesiological Taping, AE: Aerobic Exercise, Avg: Average, SD: Standard Deviation, *: p≤0.05.

DISCUSSION

The purpose of this study was to investigate the effects of KT and AE on pain, attitude, depression, and QoL in women with PD. An improvement was found in terms of attitude and QoL in the KT group. There was a decrease in terms of pain in the AE group. No difference was found after the treatment in the control group. There were differences in MPQ and MAS Time*Group interaction, but there was no difference between the KT and AE group in post-hoc tests. In conclusion, KT and AE may decrease pain and improve attitude in PD.

Lower abdominal/pelvic pain is the most salient symptom in PD. Despite the excess in the amplitude of the uterine contractions in dysmenorrhea, the severity of pain is high in cases where the basal tone rises above 50 mmHg. Pain in PD can be associated with many including being under the age of 30, having a BMI below 20, a long period of bleeding and a long cycle, a menarche age less than 12, excessive menstrual and irregular flow, excessive sterilization, premenstrual symptoms, sexual harassment history, smoking and alcohol use, obesity, depression, anxiety, and stress (5). Pain in dysmenorrhea contributes significantly to a decrease in mood and QoL (18). It was suggested that local hot application, hot showers, reducing stress, walking, sleep regulation, relaxation, and developing a positive attitude towards menstruation may be effective (19). Clarifying the attitude towards menstruation and changing it if negative is important in reducing the negative effects of dysmenorrhea on QoL. It was reported that attitudes towards menstruation changed due to body pain, general health status, mood, and physical and social functionality, which significantly reduced QoL in women with PD (18). Su and Lindell (20) stated that applied health education had a positive effect on menstruation. Our findings in MPQ and MAS scores in all groups were in agreement with the studies. We found that the participants in our study had high MPQ values and this was clearly reflected in the MAS, BDS, and SF-36 scores.

KT is an elastic and thin tape with a waterproof and breathable structure that can stay on the skin for three days, supports fascia and soft tissue, assists to increase blood and lymphatic circulation, reduces pain and muscle spasm, and provides kinesthetic awareness (21). Due to these physiological properties, it is thought that KT may be effective in reducing pain, tender points and uterine contractions. It has been reported that KT applied to sacral and suprapubic regions with ligament technique in PD is effective in reducing the level of pain and anxiety and increases the well-being of individuals (22). In another study investigating the effects of KT and lifestyle changes on pain, body awareness and QoL in women with PD, it has been shown that KT can be used to increase QoL and body awareness and reduce pain severity (23). We did not find any study investigating the effect of KT on attitude

Table 6. Post-hoc findings

			Mean difference	Confidence interval (lower/upper)	p-value
MPQ	KT group	AE group	1.312	(-9.039 to 11.662)	1.000
		Control group	1.645	(-8.705 to 11.996)	1.000
	AE group	KT group	-1.645	(-11.996 to 8.705)	1.000
		Control group	-0.333	(-10.504 to 9.837)	1.000
	Control group	AE group	-1.312	(-11.662 to 9.039)	1.000
		KT group	0.333	(-9.837 to 10.504)	1.000
MAS	KT group	AE group	-1.945	(-11.839 to 7.948)	1.000
		Control group	-12.045	(-21.939 to -2.151)	**0.012***
	AE group	KT group	1.945	(-7.948 to 11.839)	1.000
		Control group	-10.100	(-19.822 to -0.3780)	**0.039***
	Control group	AE group	12.045	(2.151 to 21.939)	**0.012***
		KT group	10.100	(0.378 to 19.822)	**0.039***

MPQ: McGill Pain Questionnaire, MAS: Menstrual Attitude Scale, KT: Kinesiological Taping, AE: Aerobic Exercise, *: p≤0.05.

and QoL in women with PD. Therefore, we would like to state that our study is the first study investigating the effect of KT on attitude and QoL in women with PD. In our study, we applied taping to the supra pubic area with 100% tension to reduce uterine contraction, using the ligament technique, for a total of 6 sessions, 2 times a week for 3 weeks, starting from the 14th day of the menstrual cycle to the KT group. We found a difference in attitude and QoL in the KT group. There was a decrease in depression but it was not significant. Due to the physiological effects of KT, we are of the opinion that it provides an improvement in the attitude and an increase in the QoL by creating awareness in body perception and interception.

AE refers to the type of repetitive, structured physical activity that requires the body's metabolic system to use oxygen to produce energy. Dehghanzadeh et al. (24), reported that the intensity of pain associated with PD decreases with AE. Armour et al. (25), supported a positive association between high-intensity AE and a reduction in the severity of PD symptoms compared to low/medium intensity exercise. Also, the effectiveness of AE in managing PD was supported. In a study conducted by Bavil et al. (26), using personal, social and lifestyle questionnaires, over 250 students with and without PD, they investigated lifestyle approaches, nutrition with dysmenorrhea, physical activity, and reported that there was a relationship between stress and social relationships. They also mentioned that exercising would act as a non-specific analgesic by improving pelvic blood circulation and increasing beta endorphin release. In a review, it was concluded that exercise reduced symptoms in dysmenorrhea (27). Booth et al. (28), was reported that people who exercised more than 3 times a week had fewer symptoms during menstruation compared to sedentary people. In a study by Vaziri et al. (10) in 2014, it was concluded that aerobic and stretching exercises reduced pain in women with PD. As a result of the study conducted by Dehnavi et al. (9) on 70 people with PD, it was shown that regular moderate-intensity AE can reduce and prevent the emergence of menstrual symptoms. In our study, we applied moderate-intensity AE, which includes walking and climbing stairs, and active ROM exercises for upper and lower extremities throughout the 14th day of the menstrual cycle, as 45-minute sessions a day, 3 days a week for 3 weeks. We found that moderate-intensity AE is effective in reducing pain in women with PD. There was a decrease in depression but it was not significant. We think that moderate-intensity AE applied regularly for 3 weeks, has an effect on the pain mechanism by accelerating blood flow and increasing well-being in PD.

Participants in the control group who did not receive any application, asked to continue their routine ADL but not doing physical exercise, we found that while the pain and attitude levels of the individuals remained almost constant, QoL was decreased and depression levels were increased. This proved the accuracy of the literature that PD increases depression levels and decreases the QoL.

We concluded that there was a difference in pain and attitude scales between the groups. Compared to the control, there were differences between the KT and AE group, but the groups had no superiority over each other. This would be due to the fact that both treatment methods have different healing mechanisms. In line with these results, we concluded that the combined use of KT and AE may reduce pain and improve attitude in women with PD.

Limitations

The limitations of this study were the inclusion of only virgin women in the study, not taking as a factor how many years women have menstruated, the inability to measure women's tolerance to pain, short duration of the study, and not determining the physical activity scores of the participants at the beginning of the study.

CONCLUSION

In conclusion, KT decreases pain, improves attitude and QoL, and AE decreases pain in women with PD. Combination of KT and AE in women with PD may reduce pain, improve attitude and improve QoL.

Ethics: The study was approved by the İstanbul Medipol University Non-Invasive Clinical Research Ethics Committee (approval number: 10840098-604.01.01, date: 11.10.2019).

Informed Consent: All participants had signed a written informed consent form, and the study has been conducted in accordance with the principles of the Declaration of Helsinki.

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Conflict of Interest: The authors declare that they have no conflict of interest.

Authors Contributions: Concept- ST, MB; Design- ST, MB; Supervision- MB; Resources and Financial Support- ST; Materials- ST; Data Collection and/or Processing- ST; Analysis and/or Interpretation- MB; Literature Search- ST, MB; Writing Manuscript- ST, MB; Critical Review- ST, MB.

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REFERENCES

1. Xu Y, Zhao W, Li T, Bu H, Zhao Z, Zhao Y, et al. Effects of acupoint-stimulation for the treatment of primary dysmenorrhoea compared with NSAIDs: a systematic review and meta-analysis of 19 RCTs. BMC Complement Altern Med. 2017;17(1):436.
2. Ghafourian M, Band NA, Pour AF, Kooti W, Rad MF, Badiee M. The role of CD16+, CD56+, NK (CD16+/CD56+) and B CD20+ cells in the outcome of pregnancy in women with recurrent spontaneous abortion. Int J Womens Health Reprod Sci. 2015;3(1):61-6.
3. Wijesiri HS, Suresh TS. Knowledge and attitudes towards dysmenorrhea among adolescent girls in an urban school in Sri Lanka. Nurs Health Sci. 2013;15(1):58-64.
4. Romans S, Clarkson R, Einstein G, Petrovic M, Stewart D. Mood and the menstrual cycle: a review of prospective data studies. Gend Med. 2012;9(5):361-84.
5. Bernardi M, Lazzeri L, Perelli F, Reis FM, Petraglia F. Dysmenorrhea and related disorders. F1000Res. 2017;6:1645.
6. Aboualsoltani F, Bastani P, Khodaie L, Mohammad S, Fazljou B. Non-pharmacological treatments of primary dysmenorrhea: a systematic review. Arch Pharm Pract. 2020;11(S1):136-42.
7. Sharghi M, Mansurkhani SM, Larky DA, Kooti W, Niksefat M, Firoozbakht M, et al. An update and systematic review on the treatment of primary dysmenorrhea. JBRA Assist Reprod. 2019;23(1):51-7.
8. ACOG. Birth control [Internet]. Washington (DC): ACOG; [cited 2021 Apr 21]. Available from: http://www.acog.org/publications/patient_education/ab020.cfm
9. Dehnavi ZM, Jafarnejad F, Kamali Z. The effect of aerobic exercise on primary dysmenorrhea: a clinical trial study. J Educ Health Promot. 2018;7:3.
10. Vaziri F, Hoseini A, Kamali F, Abdali K, Hadianfard M, Sayadi M. Comparing the effects of aerobic and stretching exercises on the intensity of primary dysmenorrhea in the students of universities of bushehr. J Family Reprod Health. 2015;9(1):23-8.
11. Lim C, Park Y, Bae Y. The effect of the kinesio taping and spiral taping on menstrual pain and premenstrual syndrome. J Phys Ther Sci. 2013;25(7):761-4.
12. Bac A, Wróbel M, Ogrodzka-Ciechanowicz K, Michalik E, Ścisłowska-Czarnecka A. The influence of the kinesio taping on selected ultrasonography measurements, and quality of life in patients with rotator cuff lesions. Sci Rep. 2020;10(1):18539.
13. Faul F, Erdfelder E, Lang AG, Buchner A. G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behav Res Methods. 2007;39(2):175-91.
14. Oksuz E, Malhan S, Tulunay FC. Turkish McGill Pain Questionnaire: reliability and validation. Value Health. 2007;10(6):A467.
15. Kulakaç Ö, Öncel S, Fırat MZ, Akcan A. Menstrual attitude questionnaire: validity and reliability study. J Clin Obstet Gynecol. 2008;18(6):347-56.
16. Hisli N. Beck Depresyon Envanterinin üniversite öğrencileri için geçerliği, güvenirliği. Psikoloji Derg. 1989;7(23):3-13.
17. Demiral Y, Ergor G, Unal B, Semin S, Akvardar Y, Kivircik B, et al. Normative data and discriminative properties of short form 36 (SF-36) in Turkish urban population. BMC Public Health. 2006;6:247.
18. Waxman A, Waxman A, Norum KR. Why a global strategy on diet, physical activity and health? The growing burden of non-communicable diseases. Public Health Nutr. 2004;7(3):381-3.
19. Mooventhan A, Nivethitha L. Scientific evidence-based effects of hydrotherapy on various systems of the body. N Am J Med Sci. 2014;6(5):199-209.
20. Su JJ, Lindell D. Promoting the menstrual health of adolescent girls in China. Nurs Health Sci. 2016;18(4):481-7.
21. Gürşen C, İnanoğlu D, Kaya S, Akbayrak T, Baltacı G. Effects of exercise and Kinesio taping on abdominal recovery in women with cesarean section: a pilot randomized controlled trial. Arch Gynecol Obstet. 2016;293(3):557-65.
22. Toprak Celenay S, Kavalci B, Karakus A, Alkan A. Effects of kinesio tape application on pain, anxiety, and menstrual complaints in women with primary dysmenorrhea: a randomized sham-controlled trial. Complement Ther Clin Pract. 2020;39:101148.
23. Doğan H, Eroğlu S, Akbayrak T. The effect of kinesio taping and lifestyle changes on pain, body awareness and quality of life in primary dysmenorrhea. Complement Ther Clin Pract. 2020;39:101120.
24. Dehghanzadeh N, Khoshnam E, Nikseresht A. The effect of 8 weeks of aerobic training on primary dysmenorrhea. Eur J Exp Biol. 2014;4(1):380-2.

25. Armour M, Smith CA, Steel KA, Macmillan F. The effectiveness of self-care and lifestyle interventions in primary dysmenorrhea: a systematic review and meta-analysis. BMC Complement Altern Med. 2019;19(1):22.

26. Bavil DA, Dolatian M, Mahmoodi Z, Baghban AA. Comparison of lifestyles of young women with and without primary dysmenorrhea. Electron Physician. 2016;8(3):2107-14.

27. Daley AJ. Exercise and primary dysmenorrhoea: a comprehensive and critical review of the literature. Sports Med. 2008;38(8):659-70.

28. Booth FW, Roberts CK, Laye MJ. Lack of exercise is a major cause of chronic diseases. Compr Physiol. 2012;2:1143-211.

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VALIDITY AND RELIABILITY OF THE HELKIMO CLINICAL DYSFUNCTION INDEX FOR THE DIAGNOSIS OF TEMPOROMANDIBULAR DISORDERS

ABSTRACT

Purpose: The Helkimo Clinical Dysfunction Index (HCDI) is a brief and easy-to-use assessment tool designed to evaluate individuals with temporomandibular disorders (TMDs). The evaluation assesses muscle strength, joint function, mobility, pain, and musculature to give a rapid overall review for various levels of treatment. Because of this, the research aimed to verify the HCDI's use in a group of TMD patients.

Methods: There were 88 participants, 44 of whom had TMD. The other 44 participants were healthy. Inter-rater concordance, predictive scores, and concurrent validity were all assessed in the study.

Results: The analysis of the receiver operating characteristic curve identified an optimal cut-off point of more than 1 point in the HCDI score that manifested a sensitivity of 81.17% alongside a specificity of 72.43% for diagnosing TMDs, thus establishing the DC/TMD protocol as the benchmark.

Conclusion: This analytical process demonstrated an area under the curve of 0.90, indicative of commendable precision.

Keywords: Helkimo, Reliability, Validity, Temporomandibular dysfunction

TEMPOROMANDİBULAR BOZUKLUKLARIN TEŞHİSİNDE HELKİMO KLİNİK DİSFONKSİYON İNDEKSİNİN GEÇERLİLİĞİ VE GÜVENİRLİĞİ

ÖZ

Amaç: Helkimo Klinik Disfonksiyon İndeksi (HCDI), temporomandibular bozukluğu (TMD) olan bireyleri değerlendirmek için tasarlanmış kısa, kullanımı kolay bir değerlendirme aracıdır. Değerlendirme, çeşitli tedavi seviyeleri için hızlı bir genel değerlendirme sağlamak amacıyla kas gücü, eklem fonksiyonu, hareketlilik, ağrı ve kas sistemini değerlendirir. Bu nedenle, araştırma HCDI'nin TMD hastasında kullanımını doğrulamayı amaçlamıştır.

Yöntem: Çalışmaya 44'ünde TMD olan 88 katılımcı dahil edildi. Diğer 44 katılımcı ise sağlıklıydı. Çalışmada değerlendiriciler arası uyum, öngörücü skorlar ve eşzamanlı geçerlilik değerlendirilmiştir.

Bulgular: Alıcı işletim karakteristik eğrisinin analizi, TMD'lerin teşhisi için %72,43 özgüllüğün yanı sıra %81,17'lik bir duyarlılık gösteren HCDI skorunda 1 puandan fazla optimal bir kesme noktası belirlenerek DC/TMD protokolünü ölçüt olarak bulundu.

Sonuç: Bu analitik süreç, yüksek bir hassasiyetin göstergesi olan 0,90'lık bir eğri altındaki alanı göstermiştir.

Anahtar Kelimeler: Helkimo, Güvenirlik, Geçerlilik, Temporomandibular disfonksiyon

INTRODUCTION

Temporomandibular disorders (TMDs) affect the temporomandibular joint (TMJ), masticatory muscles, and associated structures (1). The three main symptoms of TMDs are pain in the muscles and TMJ, abnormal jaw movements, and joint sounds (2). There are three joints in the TMJ: bilateral, diarthrodial, and temporomandibular. Each joint has an associated articular eminence, glenoid fossa, and mandibular condyle. The TMJ and the surrounding tissues are crucial for controlling mandibular movement and relieving the strain of routine tasks (including eating, swallowing, and speaking). The degenerative musculoskeletal system of TMJ disorders is linked to morphological and functional abnormalities. Common TMDs include intraarticular discal position, anatomical anomalies, and dysfunction of the associated musculature (3,4).

Clinical issues with the masticatory muscles, TMJ, surrounding bone, and soft tissue are all part of TMDs. Reduced mandibular range of motion, masticatory muscle discomfort, joint sound linked with function, widespread myofascial pain, and a functional restriction or deviation in jaw opening are all signs of temporomandibular dysfunction (5,6). When one or more of these symptoms are present, TMJ dysfunction can be diagnosed; however, condylar movement sounds alone cannot make the diagnosis. Diagnosing TMJ dysfunction syndrome does not need the presence of other symptoms such as subluxation/dislocation of the jaw, tinnitus, or vertigo (7).

Craniofacial pain is classified as a subset of TMDs. Masticatory muscle issues and related issues with the head and neck are linked to TMDs. Pain, restricted or asymmetrical mandibular mobility, and noise in the TMJ are the most typical symptoms experienced by patients with TMDs. Pain or discomfort typically restricts the muscles, TMJ, and jaw. Symptoms frequently present together include headache, tinnitus, dizziness, neck discomfort, and ear pain (8). Numerous studies have attempted to link specific characteristics to jaw pain-dysfunction syndrome (9).

The two main methods for diagnosing TMD are the history and physical examination. Diagnostic imaging may be helpful when malocclusion or intra-articular abnormalities are suspected (10). Imaging can diagnose TMD when the history and physical examination results are not apparent. Despite their uncommon usage, several imaging techniques are available to learn more about the causes of TMD (11). The initial evaluation should include panoramic radiography or plain radiography (transcranial and trans-axillary views). Acute fractures, dislocations, and severe articular degenerative disease are routinely seen during these tests. Computed tomography is preferred to traditional radiography for evaluating fragile bone morphology. Magnetic resonance imaging is one of the best modalities for a complete assessment of the joints in TMD patients (12). Another method used to diagnose TMD is diagnostic injections. When masticatory muscle trigger points are involved, local anesthetic injections can be used to pinpoint the site of jaw pain. Dentists and medical professionals who know how to anesthetize the auriculotemporal nerve region should only carry out this procedure (13).

Helkimo proposed one of the most popular indexes. The Anamnestic Index (AI) and the clinical Dysfunction Index (DI) are included in this index. The first focuses on the primary complaint, while the second examines factors including restricted range of motion, poor TMJ function, muscular discomfort, TMJ pain, and pain with mandibular movement. The resulting results can be used to categorize the malfunction's severity (14). The Helkimo Index is one of the most popular and commonly used indices for diagnosing various TMJ disorders. It has succeeded in the test in terms of time because it is straightforward and functional, enabling us to gauge the state of dysfunction. Compared to other clinical indices, it will make it possible to correlate the patient's symptoms with the clinical outcomes (15). Since there is a relationship for quantitative standards for rating the severity of TMDs, indices are crucial in figuring out how common the condition is in a specific population (16-18). Helkimo is credited with pioneering the development of indices that assess the severity and discomfort of TMD in patients (19). Therefore, the validity and accuracy of the Helkimo Index for the diagnosis of TMDs are evaluated. Since there is no Turkish version of Helkimo, it is intended to be culturally adapted to Turkish society.

METHOD

The study was designed as a cross-sectional validation. A total sample of 88 patients was used (44 TMD patients and 44 healthy people), and all of them were evaluated by this test, which lasted approximately 20 minimum.

The protocol of this study received the approval of the Marmara University Ethics Committee (date of approval: 29 December 2022; number: 183). This study was registered in the ClinicalTrials.gov protocol registration and results system (ClinicalTrials.gov ID: NCT05749224). The sample size and power calculation were performed using the G*Power 3.1 power analysis program. In the sample size calculated using the t-tests model "means: difference between two independent means (two groups)," the effect size was large (d=0.8), α error was 0.05, the 95% confidence interval, and the desired power was 95%. These parameters generated a sample size of at least 42 participants for each group. Accordingly, 97 participants were contacted, however the final sample was composed of 88 participant (44 TMD patients and 44 healthy controls) (20,21). Additionally, the necessary permissions were obtained from the

first author (Prof. Dr. Martti Helkimo) who developed Helkimo in order to make the Turkish validity and reliability of this scale (Appendix 1) (19). This study was developed between December 2022 and May 2023. The sample was selected from the İstanbul University, Physical Medicine and Rehabilitation Department patients, which provides Health Sciences Services. Interventions were performed through personal interviews. Written informed consent was obtained by explaining the aim and plan of the study to the participants.

Inclusion criteria were determined as being over 18 years old and having a diagnosis of TMJ dysfunction. Exclusion criteria include having had previous TMJ surgery, having neuromuscular diseases, and having vestibular symptoms that impair balance.

The research consists of three stages.

The first stage was making a cultural adaptation of Helkimo whose Turkish translation had been approved by Turkish society. Three separate translators independently translated the Helkimo Index from English into Turkish. One of the translators was a native English speaker. The final Helkimo Index translation into Turkish was achieved from several translations (Appendix 2). The Helkimo Index was then translated from Turkish to English by a separate translator, and any discrepancies were examined.

Participants were given a thorough explanation of each question on the scale by a physiotherapist with a doctorate degree (E.T.Ç.) before pilot research was done on the patients to gauge the scale's readability.

In the second stage, Helkimo Index was applied to the patient and control groups. This index consists of 2 components. These are Helkimo Anamnestic Component Questionnaire and Helkimo Clinical Dysfunction Component (HCDI) (15). The study aimed to demonstrate the validity and reliability features of the Turkish version of the Helkimo Index.

The patients were asked to fill in the Helkimo Anamnestic Component Questionnaire consisting of 8 questions by one physiotherapist with over 2 years of clinical experience (C.S.). The questions have two answer options: "yes" and "no." The questionnaire includes three options for the patients' answers: "0: no symptoms", "1: mild symptom" and "2: severe symptom." The questionnaire includes the following questions; "1. Do you have a sound (clicking or crepitation) in the TMJ area?", "2. Do you experience stiffness during slow jaw movement or when you wake up in the morning?", "3. Do you feel tired in your chin area?", "4. Do you have difficulty opening your mouth?", "5. Do you experience jaw-locking when opening your mouth?", "6. Do you feel pain in the TMJ located in the area where the jaw muscles are located?", "7. Do you have pain when moving your jaw?", "8. Do you have a luxation (dislocation) in your jaw?". If all questions are answered "no", the result is noted as "no symptoms." If one or more of the first three questions are answered yes, the result is "mild symptom". In patients who mark one or more yes answers from questions 4 to 8, "severe symptom" is put out as a result. A "no symptoms" result indicates the absence of TMJ disorder. Jaw fatigue sensation, jaw stiffness, and TMJ sounds (clicking or crepitus) are signs of "mild symptoms." Suppose it includes one or more symptoms of difficulty in mouth opening, jaw locking, jaw dislocation and painful movement, and painful TMJ area and/or masticatory muscles. In that case, it results in a "severe symptom."

The Temporomandibular Joint Dysfunction Protocol is used to scale the Clinical Dysfunction Components and done by senior doctor (D.D.). The protocol's content includes muscular soreness in the joint, pain with jaw movement, headache, the capacity to clench one's jaw, cryptic sounds coming from the jaw, and tenderness to probing in the temporomandibular muscles. There are five items in the Clinical Dysfunction Component. These include painful jaw motions, TMJ discomfort, alterations in joint function, and jaw mobility (21).

Jaw Mobility

The right-to-left laterotrusion and protrusion of the jaw were measured to determine jaw openness. If the measurement was 7 mm or more in protrusion and the lateral mouth displacement was 0 points, the range of motion between 4-6 mm was 1 point, and if it was less than 4 mm was 5 points. Mouth opening beyond 40 mm was given 0 points, 30-39 mm was given 1 point, and less than 30 mm was given 5 points. According to the constraint, three separate classes were created using the results from these areas. If the total score was 0, the result was 0 points (no temporomandibular dysfunction); if the score was between 1 and 4 points, the result was 1 point (mild TMJ dysfunction); if the score was more significant than 4 points, the result was 5 points (severe TMJ dysfunction).

Joint function

When evaluating changes in joint function, if the unilateral or bilateral click and laterotrusion movement was more significant than 2 mm, the process was considered less affected. If luxation/locking was observed during movement and laterotrusion movement was less than 2 mm, it was considered a severely affected function.

Painful Jaw Movements

The presence of pain while performing the movements was checked in the evaluation of painful jaw movements. Pain associated with a single movement, minor impairment, and pain occurring with more than one movement was noted as major disorder.

Muscle Pain Assessment

The pain in the chewing muscles was tested during the muscle pain assessment. It was considered a minor disorder if there was pressure sensitivity in 1 to 3 places. If there was pressure sensitivity in 4 or more places, it was considered a severe disorder. If there was no pressure sensitivity, there was no irregularity.

Temporomandibular Joint Pain

In evaluating TMJ pain, discomfort and pain on palpation in the prearticular region of the joint were investigated. Discomfort in the lateral (side) was classified as a minor disorder, and discomfort in the posterior (back) was classified as a significant disorder (21).

In the third stage, Visual Analog Scale (VAS), Neck Disability Index (NDI), dizziness Handicap inventory (DHI), headache impact scale and short form-12 health questionnaire were used and patients were asked to complete these questionnaires under the control of a physiotherapist (D.Ö.) (21).

VAS, participants were asked to indicate their perceived pain as 0 (no pain) and 10 (worst). This scale was used to measure the neck and the temporomandibular region (22).

NDI; it is a questionnaire with ten questions. The answers were reported by taking a number between 0 and 5. For each question, 0 points mean no disability, and 5 points mean total disability. A score of 0 to 5 indicates no disability, 5-14 points for low disability, 15-24 points for moderate disability, and 35-50 points for significant disability. In the study, Turkish version of NDI were used (23).

The DHI consists of 25 questions. Participants' answers were yes, no, or sometimes. This questionnaire assessed physical, emotional, and functional components. These three components had significant effects on Dizziness Properties and Quality and in 2016 the Turkish version was conducted (24).

The Headache Impact Scale is an evaluation questionnaire comprising six questions, with a total score between 36 and 78. Answers were always, almost always, sometimes, rarely, and never. This scale is valid in Turkish version (25).

Finally, quality of life was assessed using the SF-12 Brief Health Questionnaire, the short version of SF-36. It includes two components of quality of life. These are mental component and physical components and also, Turkish validity and reliability study is available (26).

Statistical Analysis

The Social Sciences Statistics Package (SPSS 23; Software version:23.0; Operating system(s): AIX, HP-UX, Linux, iOS, Solaris, Windows; document number: 256859) statistical procedures were used. For continuous data, means and standard deviations were calculated, and frequencies and percentages were calculated for categorical variables. The normality distribution of the constant variables was confirmed using the Kolmogorov-Smirnov test. The 95% confidence level ($p<0.05$) was used. The intraclass correlation coefficient (ICC) of Shrout and Fleiss, which calculates the dependability of single ratings, was employed in a one-way random effects model of the absolute agreement type to determine the agreement between the two raters for the overall HCDI score (27). Reliability was deemed inadequate when the ICC was below 0.40, moderate between 0.40 and 0.75, considerable between 0.75 and 0.90, and outstanding when the ICC was over 0.90. Pearson's correlation coefficient r was utilized to examine the concurrent validity of the HCDI with the VAS HIT-6, NDI, SF-12, and DHI. If the correlation coefficient was more significant than 0.50, it was deemed high; if it was between 0.30 and 0.50, it was considered moderate (28). The receiver operating characteristics (ROC) curves were used to assess the HCDI's capacity to distinguish between TMD sufferers and healthy individuals.

RESULTS

Characteristics of the Sample

Ninety-seven participants were contacted; however, the final sample was composed of 88 participants (44 TMD patients and 44 healthy controls). 69.3% of the participants were female with a mean age of 33.68±11.94 (range 18-64) and mean body mass index (BMI) of 24.73±4.68 (range 16.26-33.95). No significant differences were found between TMD patients and healthy controls in terms of gender distribution, age and BMI values ($p>0.05$) (Table 1).

Table 1. Comparison of demographic informations (mean ± SD or %)

	Controls (n=44)	Patients (n=44)	Test statistics
Age	32.02±11.80	35.34±11.98	t=-1.31, p>0.05
Gender			
Male	15 (34.10%)	12 (27.30%)	x^2=0.48, p>0.05
Female	29 (65.90%)	32 (72.70%)	
BMI	24.23±3.90	25.23±5.34	t=-1.00, p>0.05

SD: Standard Deviation, BMI: Body Mass Index.

Inter-Rater Reliability

The outcomes exhibited a zenith weighted kappa coefficient of 0.894 pertinent to item C, juxtaposed with a nadir value of 0.678 pertaining to item A. With respect to these coefficients, the reliability displayed a spectrum varying from moderate to substantial. Moreover, the aggregate score of the scale attained a superior level of agreement, signified by the value of 0.955 (as can be seen in Table 2).

Correlative legitimacy of the HCDI, in association with other specific and generic tools, is presented in Table 3.

Validity and Accuracy of the TMD Diagnostic Ability

The analysis of the ROC curve identified an optimal cut-off point of more than 1 point in the HCDI score that manifested a sensitivity of 81.17% alongside a specificity of 72.43% for diagnosing TMDs, thus establishing the TMD protocol as the benchmark (Table 4). This analytical process demonstrated an area under the curve (AUC) of 0.90 (Figure 1), a value indicative of commendable precision.

Table 2. Inter-rater concordance of the Helkimo items and the total score

Measure	Value	95% confidence interval	Degree of concordance
Item A1	0.689	0.314 to 0.732	Moderate
Item A2	0.681	0.325 to 0.727	Moderate
Item A	0.678	0.470 to 0.788	Moderate
Item B	0.719	0.349 to 0.767	Moderate
Item C	0.894	0.646 to 0.921	Substantial
Item D	0.657	0.322 to 0.740	Moderate
Item E	0.742	0.393 to 0.811	Moderate
Total score	0.955	0.830 to 0.988	Excellent

Table 3. Concurrent validity of the Helkimo Clinical Dysfunction Index with other specific and generic instruments

Variable	Pearson's r	p-value	Correlation
VAS	0.607	<0.001	Strong
HIT-6	0.629	<0.001	Strong
NDI	0.497	<0.001	Moderate
SF-12 physical	-0.354	0.001	Moderate
SF-12 mental	-0.023	0.833	-
DHI physical	0.309	0.003	Moderate
DHI emotional	0.280	0.008	Poor
DHI functional	0.264	0.013	Poor
DHI total	0.296	0.005	Moderate

VAS: Visual Analog Scale, HIT-6: Headache Impact Test, SF-12: Short Form-12, DHI: Dizziness Handicap Inventory, NDI: Neck Disability Index.

DISCUSSION

This study evaluated the validity and reliability of the Helkimo anamnestic and the clinical DI. The results showed that it is a valid and reliable instrument for evaluating patients with TMD, determining the degree of severity of the condition, and discriminating between affected and unaffected patients. Helkimo's indices, which include the clinical DI and the AI, are among the most used indices. The former relies heavily on the primary complaint. In contrast, the latter examines factors including restricted range of motion, poor TMJ function, muscular discomfort, TMJ pain, and pain with mandibular movement. To categorize the malfunction according to its degree of it, utilize the data that were collected (19).

Table 4. Sensitivity, specificity, and AUC values of HCDI total score by ROC curve analysis for the diagnosis of TMDS

Statistics	Value
Sensivity	81.17%
Specificity	72.43%
Significance (p)	<0.001
Positive predicted value	0.78
Negative predictive value	0.81
AUC	0.90
AUC 95% confidence interval	0.84-0.96
Standard error of AUCs	0.03

AUC: Area Under The Curve, HCDI: The Helkimo Clinical Dysfunction Index, ROC: Receiver Operating Characteristics, TMDS: Temporomandibular Disorders.

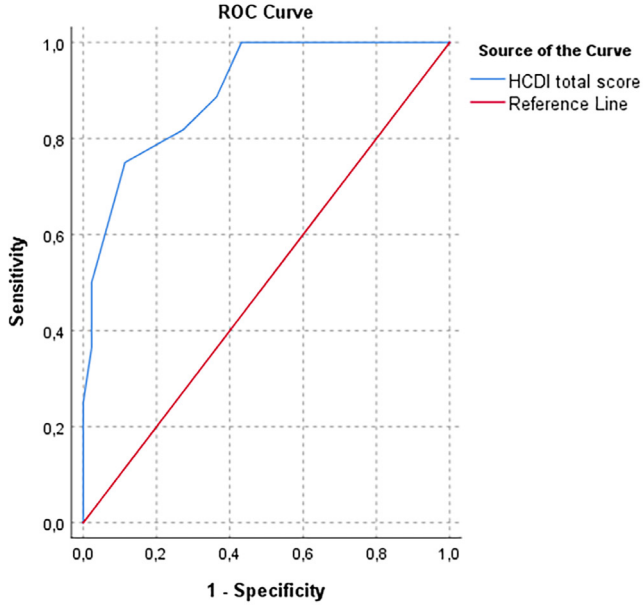

Figure 1. Receiver operating characteristic curve for HCDI.
HCDI: The Helkimo Clinical Dysfunction Index.

The most often used measure for evaluating TMD in epidemiologic research is the Helkimo index. However, this approach has come under fire for treating all symptoms equally, including those from articular to muscle problems. Additionally, the scale of 0, 1, and 5 does not provide a precise definition of the severity between score numbers and is not continuous. However, when comparing the outcomes of related investigations, the Helkimo index is helpful. Helkimo's AI gauges how well-aware the patient is of their TMD symptoms (29).

The most widely used approach in epidemiological research of TMD to assess the severity of TMD in individuals and the general population, as well as the improvement in patients' conditions following therapy, is Helkimo's DI (30). The connection between TMD, malocclusion patterns, benign joint hypermobility syndrome, and initial condylar position was examined by Barrera-Mora et al. (31) using this index. They concluded that condylar displacements in the vertical plane and anterior crossbite are risk factors for the onset of TMJ symptoms (31). Using the Helkimo index, Padala et al. (32) assessed the connection between condyle position and TMD. Vojdani et al. (33) evaluated the correlation between subjective data from a questionnaire and clinical examination. They concluded that concerning gender, women (80%) were more affected than men (62%) (33). Cone beam computed tomography (CBCT) results relevant to patients with and without the TMD were analyzed by Khojastepour et al. (34) to look into the relationship between these results and the DI. The present study's analysis of CBCT images showed distinct variations between condyles with TMD and those without. Additionally, there was a strong correlation between the total condylar bone change in TMD patients and the HCDI (34). Possible associations between clinical dysfunction indicators and the level of condylar asymmetry have been shown by research by Khojastepour et al. (35). According to the current study's results, people with a high condylar asymmetry index are more likely to develop TMD. However, the level of condylar asymmetry is not required for TMD indications and symptoms (35). These findings highlight the relevance of the HCDI in diagnosing TMD. Given the strong correlation between condylar displacements, asymmetry, and TMD symptoms, as demonstrated by previous studies, the Helkimo index serves as a valuable clinical tool for assessing dysfunction severity and identifying individuals at risk. Its applicability is further supported by CBCT analyses, which reveal distinct morphological changes in the condyles of TMD patients, reinforcing the index's role in comprehensive diagnostic assessments.

In the literature, the Helkimo index has been widely used in symptom-based TMD classification studies and its simplicity of application has made it a preferable tool in population-based studies (36-39). However, its validity, reliability and cultural adaptation have only been examined in a limited number of studies (40).

Regarding the validation study of the Helkimo index conducted by Alonso-Royo et al. (21), the HCDI showed moderate to substantial inter-rater concordance among the items and excellent concordance for the total scores. The correlation with other tests was high, the correlation with dizziness disability test (total) was moderate and the correlation with NDI test, headache impact test and physical and mental component of the quality of life was poor (r=0.339, r=0.265, r=0.187, r=0.003, r=-0.171, respectively). The prediction of TMD revealed a sensitivity of 86.67%, a specificity of 68.09% and an AUC of 0.841 (18). Similarly, the present research analysis demonstrated an optimal cut-off point of more than 1 point in the HCDI score that manifested a sensitivity of 81.17% alongside a specificity of 72.43% for diagnosing TMDs. Furthermore; the correlation with VAS and HIT-6 (headache impact test) were strong (r=0.607 and r=0.629, respectively), the correlation with NDI, SF-12 (physical) and DHI (physical and total) (r=0.497, r=-0.354, r=0.309, r=0.296, respectively) were moderate and the correlation with DHI (emotional and functional) were poor (r=0.280 and r= 0.264, respectively).

A review of the literature indicates that the Helkimo index has been widely used in assessing patient-reported outcomes of TMD in conjunction with various imaging modalities. Additionally, It has been emphasized as a potential gold standard among other assessment methods. Furthermore, numerous studies reported significant correlation between cultural adaptation of other TMD-related questionnaires with the Helkimo index. However, validity, reliability, and cultural adaptation studies of this index remain insufficient at the national level. Therefore, further research is necessary to enhance its applicability and standardization across different populations. In this context, our study contributes to the validation of the Helkimo Clinical Index within the Turkish population. Nonetheless, there has been few limitations of our study. Although, our study population did not fall into the patient category, the healthy group showed signs of TMJ dysfunction. The major drawback of the study is the discovery of symptoms in patients who did not have TMJ dysfunction as determined by doctors. The fact that the patients had a short window of time to complete the questionnaires is another one of the constraints. Although the most general psychometric characteristics were examined in this study, we did not examine the sensitivity to change or the capacity to distinguish across various TMD populations. The fact that this study was conducted only on a small group of local patients in a specific geographic area also restricts the applicability of the findings.

CONCLUSION

In conclusion, the study demonstrates that the HCDI serves a purpose for TMD diagnosis. For each item, the inter-observer concordance was between moderate and considerable, which was outstanding for the test's overall score. Concerning the Fonseca's AI, the short version of Fonseca's AI and numerical pain-rating scale (NPRS) orofacial assessment instruments, the HCDI has strong concurrent validity; the NPRS neck pain assessment, emotional and physical facets, and the total DHI value have moderate validity; and the HIT-6 instruments, the mental and physical components of the SF-12, and the functional component of the DHI have poor validity. The HCDI score that manifested a sensitivity of 81.17% alongside a specificity of 72.43% for diagnosing TMDs, thus establishing the DC/TMD protocol as the benchmark.

Ethics: The protocol of this study received the approval of the Marmara University Ethics Committee (date of approval: 29 December 2022; number: 183).

Informed Consent: Written informed consent was obtained by explaining the aim and plan of the study to the participants.

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Conflict of Interest: The authors declare that they have no conflicts of interest.

Author Contributions: Concept- ETÇ, EAK, FŞB; Design- ETÇ, CS, DÖ, HY, EAK; Supervision- ETÇ; Resources and Financial Support- ETÇ, CS, DÖ, HY, DD; Materials- ETÇ, CS, DÖ, HY, DD; Data Collection and/or Processing- ETÇ, CS, DÖ, HY; Analysis and/or Interpretation- ETÇ, CS, DÖ, HY; Literature Search- ETÇ, CS, DÖ, HY; Writing Manuscript- ETÇ, CS, DÖ, HY; Critical Review- ETÇ, CS, DÖ, HY.

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REFERENCES

1. Kılınç HE, Ulusoy B, Ergun N. Acute effect of created muscle fatigue in cervical region on temporomandibular joint in healthy women. Turk J Physiother Rehabil. 2015;26(1):20-5.
2. Xie C, Lin M, Yang H, Ren A. Prevalence of temporomandibular disorders and its clinical signs in Chinese students, 1979-2017: a systematic review and meta-analysis. Oral Dis. 2019;25(7):1697-706.
3. de Felicio CM, Melchior Mde O, Da Silva MA. Clinical validity of the protocol for multi-professional centers for the determination of signs and symptoms of temporomandibular disorders. Part II. Cranio. 2009;27(1):62-7.
4. Murphy MK, MacBarb RF, Wong ME, Athanasiou KA. Temporomandibular disorders: a review of etiology, clinical management, and tissue engineering strategies. Int J Oral Maxillofac Implants. 2013;28(6):e393-414.
5. Damar Örenler S, Tuncer A, Najafov E. A comparison of manual therapy and splint therapy in patients diagnosed with myofascial temporomandibular dysfunction with sleep bruxism. Turk J Physiother Rehabil. 2022;33(2):89-97.
6. Kılınç HE, Ünver B, Sarı M, Tunç AR, Bek N. Determinants of temporomandibular dysfunction and bruxism in academicians. Turk J Physiother Rehabil. 2022;33(1):31-38.
7. Moss RA, Garrett JC. Temporomandibular joint dysfunction syndrome and myofascial pain dysfunction syndrome: a critical review. J Oral Rehabil. 1984;11(1):3-28.
8. Liu F, Steinkeler A. Epidemiology, diagnosis, and treatment of temporomandibular disorders. Dent Clin North Am. 2013;57(3):465-79.
9. Scrivani SJ, Keith DA, Kaban LB. Temporomandibular disorders. N Engl J Med. 2008;359(25):2693-705.
10. Li DTS, Leung YY. Temporomandibular disorders: current concepts and controversies in diagnosis and management. Diagnostics (Basel). 2021;11(3):459.
11. Hunter A, Kalathingal S. Diagnostic imaging for temporomandibular disorders and orofacial pain. Dent Clin North Am. 2013;57(3):405-18.
12. Rawlani S, Rawlani S, Motwani M, Degwekar S, Bhowte R, Baheti R. Imaging modality for temporomandibular joint disorder-a review. Journal of Datta Meghe Institute of Medical Sciences University. 2010;5(2):126-33.
13. Nascimento MM, Vasconcelos BC, Porto GG, Ferdinanda G, Nogueira CM, Raimundo RD. Physical therapy and anesthetic blockage for treating temporomandibular disorders: a clinical trial. Med Oral Patol Oral Cir Bucal. 2013;18(1):e81-5.
14. Bessette RU, Bishop B, Mohl NO. Duration of masseteric silent period in patients with TMJ syndrome. J Appl Physiol. 1971;30(6):864-9.
15. Rani S, Pawah S, Gola S, Bakshi M. Analysis of Helkimo index for temporomandibular disorder diagnosis in the dental students of Faridabad city: a cross-sectional study. J Indian Prosthodont Soc. 2017;17(1):48-52.
16. List T, Axelsson S. Management of TMD: evidence from systematic reviews and meta-analyses. J Oral Rehabil. 2010;37(6):430-51.
17. Schiffman E, Ohrbach R. Executive summary of the diagnostic criteria for temporomandibular disorders for clinical and research applications. J Am Dent Assoc. 2016;147(6):438-45.
18. Meng H, Dai J, Li Y. Quantitative sensory testing in patients with the muscle pain subtype of temporomandibular disorder: a systemic review and meta-analysis. Clin Oral Investig. 2021;25(12):6547-59.
19. Helkimo M. Studies on function and dysfunction of the masticatory system. IV. Age and sex distribution of symptoms of dysfunction of the masticatory system in Lapps in the north of Finland. Acta Odontol Scand. 1974;32(4):255-67.
20. Hobart JC, Cano SJ, Warner TT, Thompson AJ. What sample sizes for reliability and validity studies in neurology? J Neurol. 2012;259(12):2681-94.
21. Alonso-Royo R, Sánchez-Torrelo CM, Ibáñez-Vera AJ, Zagalaz-Anula N, Castellote-Caballero Y, Obrero-Gaitán E, et al. Validity and reliability of the Helkimo clinical dysfunction index for the diagnosis of temporomandibular disorders. Diagnostics. 2021;11(3):472.
22. Carlsson AM. Assessment of chronic pain. I. Aspects of the reliability and validity of the visual analogue scale. Pain. 1983;16(1):87-101.

23. Telci EA, Karaduman A, Yakut Y, Aras B, Simsek IE, Yagli N. The cultural adaptation, reliability, and validity of Neck Disabilitiy Index in patients with neck pain: a Turkish version study. Spine (Phila Pa 1976). 2009;34(16):1732-5.

24. Canbal M, Cebeci S, Duyan G, Kurtaran H, Arslan İ. A study of reliability and validity for the Turkish version of dizziness handicap inventory. TJFM&PC. 2016;10(1):19-24.

25. Arıkan H. Translation, cultural adaptation, reliability, and validity of the Turkish version of the headache impact questionnaire. Karya J Health Sci. 2024;5(3):94-9.

26. Soysal Gündüz Ö, Mutlu S, Aslan Basli A, Gül C, Akgül Ö, Yilmaz E, et al. Validation of the Turkish form of short form-12 health survey version 2 (SF-12v2). Arch Rheumatol. 2021;36(2):280-6.

27. Alinaghi F, Calov M, Kristensen LE, Gladman DD, Coates LC, Jullien D, et al. Prevalence of psoriatic arthritis in patients with psoriasis: a systematic review and meta-analysis of observational and clinical studies. J Am Acad Dermatol. 2019;80(1):251-65.

28. Badel T, Savić Pavičin I, Krapac L, Zadravec D, Rosić D. Psoriatic arthritis and temporomandibular joint involvement - literature review with a reported case. Acta Dermatovenerol Croat. 2014;22(2):114-21.

29. Nokar S, Sadighpour L, Shirzad H, Shahrokhi Rad A, Keshvad A. Evaluation of signs, symptoms, and occlusal factors among patients with temporomandibular disorders according to Helkimo index. Cranio. 2019;37(6):383-8.

30. Paknahad M, Shahidi S. Association between mandibular condylar position and clinical dysfunction index. J Craniomaxillofac Surg. 2015;43(4):432-6.

31. Barrera-Mora JM, Espinar Escalona E, Abalos Labruzzi C, Llamas Carrera JM, Ballesteros EJ, Solano Reina E, et al. The relationship between malocclusion, benign joint hypermobility syndrome, condylar position and TMD symptoms. Cranio. 2012;30(2):121-30.

32. Padala S, Padmanabhan S, Chithranjan AB. Comparative evaluation of condylar position in symptomatic (TMJ dysfunction) and asymptomatic individuals. Indian J Dent Res. 2012;23(1):122.

33. Vojdani M, Bahrani F, Ghadiri P. The study of relationship between reported temporomandibular symptoms and clinical dysfunction index among university students in Shiraz. Dent Res J (Isfahan). 2012;9(2):221-5.

34. Khojastepour L, Vojdani M, Forghani M. The association between condylar bone changes revealed in cone beam computed tomography and clinical dysfunction index in patients with or without temporomandibular joint disorders. Oral Surg Oral Med Oral Pathol Oral Radiol. 2017;123(5):600-5.

35. Khojastepour L, Omidi M, Vojdani M, Bagheri K. Investigating possible correlation between condylar asymmetry and clinical dysfunction indices in patients with temporomandibular dysfunction using cone-beam computed tomographic. J Craniomaxillofac Surg. 2019;47(3):438-42.

36. Ardizone I, Celemin A, Aneiros F, del Rio J, Sanchez T, Moreno I. Electromyographic study of activity of the masseter and anterior temporalis muscles in patients with temporomandibular joint (TMJ) dysfunction: comparison with the clinical dysfunction index. Med Oral Patol Oral Cir Bucal. 2010;15(1):e14-9.

37. Bonjardim LR, Lopes-Filho RJ, Amado G, Albuquerque RL Jr, Goncalves SR. Association between symptoms of temporomandibular disorders and gender, morphological occlusion, and psychological factors in a group of university students. Indian J Dent Res. 2009;20(2):190-4.

38. Nomura K, Vitti M, Oliveira AS, Chaves TC, Semprini M, Siéssere S, et al. Use of the Fonseca's questionnaire to assess the prevalence and severity of temporomandibular disorders in Brazilian dental undergraduates. Braz Dent J. 2007;18(2):163-7.

39. Franco-Micheloni AL, Fernandes G, Gonçalves DA, Camparis CM. Temporomandibular disorders among Brazilian adolescents: reliability and validity of a screening questionnaire. J Appl Oral Sci. 2014;22(4):314-22.

40. Borges REA, Mendonça LDRA, Dos Santos Calderon P. Diagnostic and screening inventories for temporomandibular disorders: a systematic review. Cranio. 2021;42(3):341-7.

Appendix 1. English version of Helkimo index

Table 1. Questionnaire for anamnestic component		
Name:		
Age:		
Gender:		
1. Do you have a sound (clicking or crepitation) in the area of TMJ?	Yes	No
2. Do you have jaw rigidity during awakening or slow movement of mandible?	Yes	No
3. Do you feel fatigue in the jaw area?	Yes	No
4. Do you have difficulty while opening mouth?	Yes	No
5. Do you have locked mandible during opening the mouth?	Yes	No
6. Do you have pain in the TMJ in the area of masticatory muscles?	Yes	No
7. Do you have pain during movement of mandible?	Yes	No
8. Do you have luxation of mandible?	Yes	No
TMJ: Temporomandibular Joint		

Table 2. Clinical dysfunction component	
Component	**Details**
Mandibular opening	>40 mm 30-39 mm >30 mm
Mandibular deviation during lowering	<2 mm 2-5 mm >5 mm
TMJ dysfunction	No impairment Palpable clicking Evident clicking
TMJ pain	No pain Palpable pain
Muscle pain	No pain Palpable pain Palpated reflex
TMJ: Temporomandibular Joint.	

Appendix 2. Turkish version of Helkimo index

Tablo 1. Helkimo anamnestik komponent anketi		
İsim:		
Yaş:		
Cinsiyet:		
Temporomandibular eklem bölgesinde sese (tıkırtı veya krepitasyon) sahip misiniz?	**Evet**	**Hayır**
Yavaş çene hareketi sırasında veya sabah uyandığınızda çene sertliği yaşıyor musunuz?	**Evet**	**Hayır**
Çene bölgenizde yorgunluk hissediyor musunuz?	**Evet**	**Hayır**
Ağızınızı açarken zorluk yaşıyor musunuz?	**Evet**	**Hayır**
Ağızınızı açarken çene kilitlenmesi yaşıyor musunuz?	**Evet**	**Hayır**
Çene kaslarının bulunduğu bölgede yer alan temporomandibular eklemde ağrı hissediyor musunuz?	**Evet**	**Hayır**
Çenenizi hareket ettirirken ağrınız oluyor mu?	**Evet**	**Hayır**
Çenenizde bir lüksasyon (çıkık) var mı?	**Evet**	**Hayır**

Tablo 2. Klinik disfonksiyon (fonksiyon bozukluğu) komponenti	
Çene mobilitesinde etkilenim	
Dikey;	**Yatay;**
30-39 mm: Hafif bozulmuş hareket	**4-6 mm:** Hafif bozulmuş hareket
≤29 mm: Ciddi şekilde bozulmuş hareket	**≤3 mm:** Ciddi şekilde bozulmuş hareket
≥40 mm: Normal eklem hareket açıklığı	**≥ 7 mm:** Normal eklem hareket açıklığı
Çene fonksiyonunda değişim	
1. Tek taraflı veya çift taraflı tıkırtı/sürtünme laterotrüzyon ≥2 mm=Hafif bozulmuş hareket	
2. Hareket sırasında luksasyon/kilitlenme=Ciddi şekilde bozulmuş hareket	
3. Yumuşak hareket, ses yok/laterotrüzyon <2 mm=Normal fonksiyon	
Ağrılı hareket	
1. Bir hareketle ilişkili ağrı=Minör bozukluk	Bir hareketle ilişkili ağrı=Minör bozukluk
2. İki veya daha fazla hareketle ilişkili ağrı=Şiddetli bozukluk (ağrısız hareket=Normal fonksiyon)	İki veya daha fazla hareketle ilişkili ağrı=Şiddetli bozukluk (ağrısız hareket=Normal fonksiyon)
Kas ağrısı	
1. 1-3 yerde basınca duyarlılık=Minör bozukluk	
2. 4 veya daha fazla yerde basınca duyarlılık=Şiddetli bozukluk	
3. Basınca duyarlılık yok=Bozukluk yok	
Temporomandibular eklem ağrısı	
1. Lateral basınca duyarlılık=Minör bozukluk	
2. Posterior basınca duyarlılık=Şiddetli bozukluk	
3. Basınca duyarlılık yok=Bozukluk yok	

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TÜRK FİZYOTERAPİ VE REHABİLİTASYON DERGİSİ

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EFFECT OF PILATES ON MOVEMENT PATTERNS, BALANCE AND FATIGUE LEVEL IN CHILDREN WITH SPASTIC DIPLEGIC CEREBRAL PALSY

ABSTRACT

Purpose: Children with cerebral palsy (CP) exhibit varying degrees of impairments that affect the patient's mobility and ability to perform activities of daily living. It restricts the patient's capacity to stay balanced and increase energy expenditure. Although the benefits of regular exercise for patients with CP are known, there is a need for more studies, which deal with the effects of different exercise approaches in them. Therefore, the aim of the present study is to investigate the effects of Pilates on sit-to-stand (STS) movement patterns, balance and fatigue in ambulatory children with CP.

Methods: Present study was a randomised controlled trial which was conducted at the Ved Special School, Sampoorna Special School, Abhyaas Special School in Delhi and the SGT Medical College Hospital and Research Institute in Gurugram, Haryana from October 2022 to March 2023. Thirty-two children (7-12 years) with spastic diplegic CP and Gross Motor Function Classification System I and II were randomly assigned into two groups. The study group underwent pilates and conventional treatment and the control group received conventional treatment alone. Images of the subjects' STS movement pattern were shot from the side through a camera, and 15 items were used to assess the condition of the subjects' extremities. Balance and fatigue were measured with Pediatric Balance Scale and Modified Borg Scale respectively at baseline, 4th week and 8th week.

Results: Significant improvements were observed in STS movement pattern in the pilates group. Significantly, greater improvements were also observed for other variables such as balance and fatigue ($p<0.001$) in response to adding pilates exercise program to conventional treatment versus conventional treatment alone.

Conclusion: Children with diplegic CP benefit more from pilates exercises in addition to conventional therapy when it comes to improving their functional movements and fatigue than from conventional therapy alone.

Keywords: Balance, Cerebral palsy, Fatigue, Pilates, Spasticity

PİLATES'İN SPASTİK DİPLEJİK SEREBRAL PALSİLİ ÇOCUKLARDA HAREKET DÜZENLERİ, DENGE VE YORGUNLUK DÜZEYİ ÜZERİNE ETKİSİ

ÖZ

Amaç: Serebral palsili (SP) çocuklarda, hareket kabiliyetini ve günlük yaşam aktivitelerini yerine getirme becerisini etkileyen farklı derecelerde bozukluklar görülmektedir. Bu durum, hastanın dengede kalma kapasitesini kısıtlamakta ve enerji harcamasını artırmaktadır. SP'li bireylerde düzenli egzersizin faydaları bilinmesine rağmen, farklı egzersiz yaklaşımlarının etkilerini ele alan daha fazla çalışmaya ihtiyaç vardır. Bu nedenle, bu çalışmanın amacı, ayaktan tedavi gören SP'li çocuklarda Pilates'in otur-kalk (STS) hareket paternleri, denge ve yorgunluk üzerindeki etkilerini araştırmaktır.

Yöntem: Bu çalışma, Ekim 2022'den Mart 2023'e kadar Delhi'deki Ved Özel Okulu, Sampoorna Özel Okulu, Abhyaas Özel Okulu ve Gurugram, Haryana'daki SGT Tıp Koleji Hastanesi ve Araştırma Enstitüsü'nde gerçekleştirilen randomize kontrollü bir araştırmadır. Spastik diplejik SP'li ve Kaba Motor Fonksiyon Sınıflandırma Sistemi I ve II düzeyinde olan otuz iki çocuk (7–12 yaş) rastgele iki gruba ayrılmıştır. Çalışma grubuna pilates egzersizleri ve konvansiyonel tedavi, kontrol grubuna ise yalnızca konvansiyonel tedavi uygulanmıştır. Deneklerin STS hareket paternleri bir kamera aracılığıyla yandan kaydedilmiş ve ekstremitelerin durumunu değerlendirmek için 15 madde kullanılmıştır. Denge ve yorgunluk, sırasıyla başlangıçta, 4. haftada ve 8. haftada Pediatrik Denge Ölçeği ve Modifiye Borg Ölçeği ile ölçülmüştür.

Bulgular: Pilates grubunda STS hareket paterninde anlamlı iyileşmeler gözlenmiştir. Ayrıca, konvansiyonel tedaviye pilates egzersiz programının eklenmesiyle, yalnızca konvansiyonel tedaviye kıyasla denge ve yorgunluk gibi diğer değişkenlerde de daha belirgin iyileşmeler elde edilmiştir ($p<0,001$).

Sonuç: Diplejik SP'li çocuklar, fonksiyonel hareketlerini geliştirme ve yorgunluğu azaltma açısından yalnızca konvansiyonel terapiye göre, pilates egzersizlerinin de dahil edildiği tedavilerden daha fazla yarar sağlamaktadır.

Anahtar Kelimeler: Denge, Serebral palsi, Yorgunluk, Pilates, Spastisite

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INTRODUCTION

Children with cerebral palsy (CP) exhibit varying degrees of impairments brought on by a non-progressive brain injury or a brain abnormality that developed in the growing foetus or infant (1). These limitations may cause movement patterns to deviate, which can decrease performance and increase energy use while engaging in functional activities (2). Standing up from a chair is one of the most basic functional actions that children carry out numerous times every day. According to reports, the sit-to-stand (STS) task is the most prevalent essential activity in daily life (3). It is a skill for upright movement and a requirement for learning functional skills (4). To govern the change from a sitting to a standing position, STS movements necessitate consistent coordination between body parts. Additionally, it involves a change from a more stable position (sitting) to a less stable one (standing), which is an antigravity movement. Therefore, STS is considered to be a more demanding movement which adequately challenges the neuromuscular system. Previous literature has pointed out that children with CP had a weakened capacity to begin the lower limb joint movements required to assume the standing posture (5,6).

One more aspect of children with CP's daily existence is fatigue. Children with CP exhibit greater energy expenditure during specific activities like walking since they have several motor deficits. Additionally, a lower anaerobic threshold in CP suggests that children with the condition walk near to or above their anaerobic threshold, which causes early tiredness. Low levels of physical activity as a preventative measure to avoid fatigue may result from the high energy demands and lower anaerobic threshold, exacerbating the previously indicated vicious circle (7).

The capacity to maintain balance is essential for mastering the majority of functional abilities. Balance control enables a child to recover from unanticipated balance disturbances caused by accidents like trips and falls or by self-inflicted instability from movements that push them close to their limit of stability. According to Tarakci et al. (8), motor abnormalities in CP frequently come with poor balance control. Children with CP frequently need intense physical therapy instruction because of their impaired motor skills. Following involvement in a range of intervention programmes, clinical research has shown considerable improvements in the balance of children with CP (9).

Key objective of therapeutic interventions is to achieve the highest level of function. Pilates is a set of exercises that include coordination, strengthening, and stretching (10). Fundamental principles of pilates exercise include breathing, attention, control, centering, precision, and fluidity. Pilates places a strong emphasis on core stability and strength while coordinating the movement of the upper and lower extremities (11). However, there exists only scarce research on the effect of pilates exercise in neurological and respiratory of children and adults. Some preliminary evidence in the form of a recent case study of a 9-year-old kid with hemiplegic CP showed that pilates intervention could enhance postural control and muscle strength in both the affected and unaffected limbs (12). These findings suggests more research to be conducted in neurological population so as to understand the pilates induced changes in detail. Therefore, objective of the present study was to examine the impact of pilates exercises on movement patterns, balance, and fatigue in children with CP.

METHOD

Study Design

This randomised controlled trial was conducted at the Ved Special School, Sampoorna Special School, Abhyaas Special School in Delhi and the SGT Medical College Hospital and Research Institute in Gurugram, Haryana from October 2022 to March 2023. Ethical clearance was obtained from Departmental Ethics Committee, Faculty of Physiotherapy, Shree Guru Gobind Singh Tricentenary University, Gurugram, before recruiting subjects (proposal ID: SGTU/FPHY/2022/421, approval date: 12 October 2022, meeting held on 8 October 2022). The subjects' parents were explained about the nature and procedures of the study and a written assent was obtained from them for participation of their ward into the study.

Participant Recruitment and Allocation

The inclusion criteria consisted of diagnosed cases of spastic diplegic CP falling into gross motor function classification system (GMFCS) level I or II, age between 7-12 years. Those children who were able to do STS movement by holding the handrail after hearing verbal command were included. Those children having recent surgery to lower limbs (within one year), botulinum toxin-A or serial casting to lower limbs within the last three months were excluded. Those children who completed a core exercise group within the previous six months and those who had neurological or orthopaedic conditions unrelated to CP were also excluded from the study.

G-Power software version 3.1 was used to determine the sample size. With alpha error of 0.05, the effect size 1.05, power of 80%, sample size came out to be 32 (13). Totally 42 subjects were screened for spastic diplegic CP and after applying the inclusion/exclusion criteria, 32 subjects were recruited in the study (Figure 1). Computerised random assignment was used to assign children at random to either study group or a control group. Group allocation was performed using numbered, sealed, and opaque black envelopes by an investigator not involved in data collection. In order to ensure concealed allocation, the group assignment was not disclosed to the physical therapist who gathered the data.

Outcome Measures

Demographic characteristics of the children were recorded. Modified Ashworth Scale was used to grade the spasticity level of hamstrings, quadriceps, hip adductors and plantar flexors (14). The GMFCS (kappa 0.76 to 0.88) was used to determine the gross motor function level of the children (15).

Movement Pattern (Sit-to-Stand Activity)

STS movement is widely performed in daily life and an important prerequisite for acquisition of functional abilities. STS is a transitional movement to the upright posture that requires movement of the center of mass from a stable position to a less stable one over extended lower extremities. It is considered a biomechanical demanding task, since it requires greater knee and hip peak joint moments, as well as high levels of neuromuscular coordination to regulate horizontal and vertical momentum transfer. The evaluation of STS activity consisted of 15 items. The evaluation's goal was to compare the joint mobility and compensatory motion of the STS motions of healthy children vs children with CP. Each of these evaluation criteria examined the sagittal plane joint movement of each child's dominant hand side. These 15 elements were used to identify typical movements, which were then classified as YES or NO (16-18).

STS movements were captured using one iPhone camera, which was positioned on the side of the subjects' dominant hand. On the lateral malleolus, lateral femoral condyle, greater trochanter, and acromion, markers were unilaterally positioned. Each individual performed the STS motions three times after hearing an oral explanation of the entire technique. These 15 factors served as the basis for identifying the characteristics of STS movements and recording them as YES or NO (Table 1).

Balance

Pediatric Balance Scale (PBS) was used to evaluate balance in children with spastic diplegic CP. It is a modified version of Berg Balance Scale, which is used to evaluate balance in children with mild to severe motor impairments. This scale comprised of 14 common functional tasks (19). The maximum score on this scale is 56. Higher score indicated greater balance abilities in children with little to no motor impairments. Lower total test scores indicated moderate balance problems (or severe if the scores are extremely low or 0) and motor impairment.

Level of Fatigue

An indication of fatigue is the rate of perceived exertion. Modified Borg Scale was used to measure level of fatigue in children with spastic CP in accordance with previous studies (20,21). "Modified Borg Scale rates perceived exertion by the subject. It starts at number 0 where breathing is causing no difficulty at all and progresses through to number 10 where breathing difficulty is maximum."

Intervention

The sessions were conducted at physiotherapy department of **Shree Guru Gobind Singh Tricentenary University** and Paediatric Physiotherapy Unit of Ved Special School, Sampoorna Special

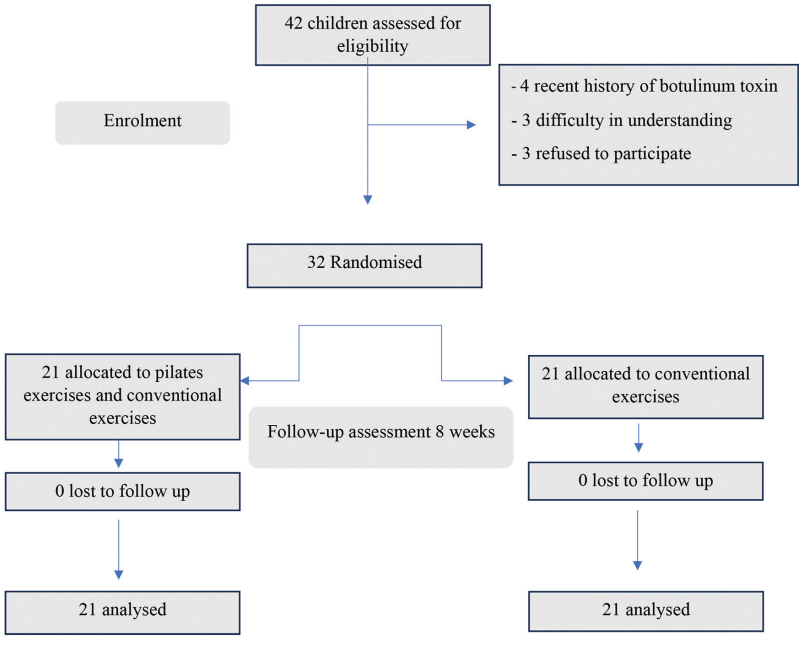

Figure 1. Flow of the participants through the study.

Table 1. Frame of reference of STS movements	
T1	The head and trunk were vertically stretched to the ground
T2	Trying to grab the handrail, the trunk tilted forward
T3	After grabbing the handrail, the trunk came to a stop
T4	After grasping the handrail, the trunk began to tilt further anteriorly
T5	When the trunk was tilted most anteriorly, the acromion was positioned ahead of the lateral malleolus
T6	After securing the handrail, the buttocks pushed forward and lifted their hips off the seat
T7	After lifting the handrail and angling the hip off the seat, the knee joint advanced
T8	While the hip is raised off the seat, the foot is dragged back
T9	Following hip off the seat, knee joint advanced
T10	After the hip left the seat, the lower thigh anteriorly inclined
T11	After lifting the hip from the seat, the foot fully grounded to the floor
T12	After lifting the hip from the seat, the head flexed more than the trunk
T13	Following hip off the seat, the acromion is placed front of the lateral malleolus
T14	In order to stand erect, the knee joint was shifted backward
T15	When in a standing position, the lower extremity and the trunk extend vertically to the ground
STS: Sit-to-Stand.	

School, Abhyaas Special School under the supervision of a physiotherapist who was certified pilates therapist and had ten years of experience working with children having CP. Face-to-face intervention was given to each subject and each subject was treated individually i.e. one physiotherapist per one child. A unique "tailor made" program was created for every child based on his individual abilities.

Study Group (Pilates Programme Along with Conventional Treatment)

Each pilates session lasted for 30 minutes, and they were spaced out over the course of 8 weeks. First phase was of 4 weeks, second was of 2 weeks and third phase was also of 2 weeks. There were two sessions in a week. Sessions were made progressively challenging by changing the position or increasing the hold time. The study group also received 30 min of conventional exercises (explained under the section "conventional group") along with pilates programme.

Pilates Programme (Appendix 1)

1. Thoracic rotation with the help of bow and arrow exercises,

2. Elongation of spine with pelvic stabilization by knee lift and aeroplane exercises,

3. Stabilisation of lumbar spine and pelvis by arm and leg lift exercises,

4. Diagonal patterns of upper limb by shoulder separation exercises,

5. Segmental spinal mobility by roll up exercises,

6. Hip dissociation by leg float exercises,

7. Bridging by pelvic curl exercises,

8. Hip abduction by clam shell exercises,

9. Spinal extension by dart exercises,

10. Superman in prone by alternate arm and leg lift exercises (22).

Control Group (Conventional Treatment)

Exercises for postural stability in various positions and surfaces were performed by both groups. These included stretching of hip flexors and adductors, knee flexors and extensors, and calf muscle. The stretching was performed three times per session, with a 30-s hold each time and an interval of 30 s. Strengthening included curl-ups and hip extension in prone, the hip abduction in side lying, knee flexion in prone, and knee extension in high sitting. Walking in all directions, standing on rough surface, standing on a soft surface, step down, step up, tandem standing, tandem walking, single leg standing, were also given. The intervention lasted for 8 weeks, with two sessions of 30 minutes each in a week. The strengthening exercise was performed in 2-3 sets with 10 repetitions per set and with a rest interval of 2-3 min between sets. A minimum rest period of 48 h was allowed between sessions. The exercise progressed uniformly throughout the 8 weeks of training by increasing the number of sets.

Both groups underwent the intervention process for a period of 8 weeks, and outcome variables were evaluated at baseline, after 4 weeks, and at the end of 8th week.

Statistical Analysis

Data analysis was performed with the software package IBM SPSS (version 20) for windows. To test the normality of the data, the Shapiro-Wilk test was used; variables which were found to be non-normal (PBS and Modified Borg) were log-transformed before further analysis. Demographic characteristics (such as age, weight, height, and body mass index), outcome variables-PBS, and Modified Borg Scale were compared between the groups using an independent t-test. Descriptive data was expressed as mean and standard deviations. Chi-square test was used to compare gender, GMFCS level, spasticity grade (measured by Modified Ashworth Scale). To assess the difference between the groups and across three time points, a 2 × 3 repeated measure analysis of variance was employed to evaluate the main effect of time (pre to post), group (study group vs. control group) and group×time interaction effect (change in the variable in the groups across two time points). Repeated measures ANOVA is a popular and most robust inferential parametric test to be applied in such research designs. Significance level was set at $p<0.05$ for the present study.

RESULTS

Demographic Characteristics and Baseline Data

No statistically significant differences were found between the groups for demographic and outcome variables at baseline ($p>0.05$) (Table 2).

At 4 weeks, component T6 showed a significant difference with a p-value of 0.033, indicating that the study and control groups differ significantly for this component at this time point. At 8 weeks, component T6 remained significant with a p-value of 0.028 and Component T11 showed a statistically significant difference with a p-value of 0.007, highlighting the significant effect for this component after 8 weeks. In study group, most components showed a steady increase over time, with significant improvements noted in T1, T3, T4, T7, T9, T11, and T12 while in control group , improvements were less pronounced than the study group, with some components showing minor changes or remaining stable. There is little to no increase for components such as T1, T4, T6, T7, and T11 (Table 3).

Statistical analysis revealed significant changes in the outcome variables in response to addition of pilates exercise program to conventional treatment for effects of time ($p<0.001$) and group × time interaction ($p<0.001$) in PBS. Mean values of PBS showed a significant difference [study group (49.81±2.88) versus control group (48.19±4.02)] after 8 weeks of intervention ($p<0.001$). Percentage increase in PBS was found to be 5.68 % in the study group versus 4.19% control group. Perceived exertion measured by modified borg scale also demonstrated significantly greater improvement in the study group as compared to control group ($p<0.005$). Percentage decrease in perceived exertion was found to be greater in the study group versus control group (40.26 % versus 23.78 %) (Table 4).

Findings of the post-hoc analysis revealed that pilates training program led to significant improvement in outcomes of PBS and perceived exertion at both 4 weeks and 8 weeks in spastic CP children (Table 5).

Table 2. Baseline characteristics of spastic diplegic CP children in the study

Characteristics	Study group (n=16) Mean ± SD	Control group (n=16) Mean ± SD	p-value
Age (years)	8.69±2.15	9.75±2.32	0.19
BMI (kg/m^2)	22.42±3.65	23.68±3.68	0.339
Gender, n (%)			
Male	12 (75%)	11 (68.75%)	0.694
Female	4 (25%)	5 (31.25%)	
Modified Ashworth Scale, n (%)			
Grade 1	7 (43.8%)	8 (50%)	0.771
Grade 1+	4 (25%)	3 (18.8%)	
Grade 2	5 (31.2%)	5 (31.2%)	
GMFCS			
Level I	7 (43.8%)	11	0.154
Level II	9 (56.2%)	5	
PBS	46.25±4.05	47.13±3	0.494
BORG Scale	6.56±1.26	6.06±0.92	0.212

CP: Cerebral Palsy, p-value: Probability Value, SD: Standard deviation, BMI: Body Mass Index, GMFCS: Gross Motor Function Classification System, PBS: Pediatric Balance Scale.

Table 3. Results of comparison of sit-to-stand movement at baseline, 4 weeks and 8 weeks in study and control group

Components		Study group Mean ± SD	Control group Mean ± SD	Chi-square	p-value	Study group Mean ± SD	Control group Mean ± SD	Chi-square	p-value	Study group Mean ± SD	Control group Mean ± SD	Chi-square	p-value
		Baseline				4 weeks				8 weeks			
T1	NO	5 (31.2%)	6 (37.5%)	0.1	0.71	3 (18.8%)	5 (31.2%)	0.67	0.41	2 (12.5%)	5 (31.2%)	1.65	0.2
	YES	11 (68.8%)	10 (62.5%)			13 (81.2%)	11 (68.8%)			14 (87.5%)	11 (68.8%		
T2	NO	0	0	-	-	0	0	-	-	0	0	-	-
	YES	16 (100%)	16 (100%)			16 (100%)	16 (100%)			16 (100%)	16 (100%)		
T3	NO	8 (50%)	6 (37.5%)	0.5	0.48	7 (43.8%)	5 (31.2%)	0.53	0.47	2 (12.5%)	4 (25%)	0.82	0.37
	YES	8 (50%)	10 (62.5%)			9 (56.2%)	11 (68.8%)			14 (87.5%)	12 (755)		
T4	NO	9 (56.2%)	8 (50%)	0.1	0.72	6 (37.5%)	8 (50%)	0.51	0.48	4 (25%)	7 (43.8%)	1.25	0.26
	YES	7 (43.8%)	8 (50%)			10 (62.5%)	8 (50%)			12 (75%)	9 (56.2%)		
T5	NO	0	0	-	-	2 (12.5%)	1 (6.2%)	0.37	0.54	4 (25%)	2 (12.5%)	0.82	0.37
	YES	16 (100%)	16 (100%)			14 (87.5%)	15 (93.8%)			12 (75%)	14 (87.5%)		
T6	NO	6 (37.5%)	10 (62.5%)	2	0.16	4 (25%)	10 (62.5%)	4.57	0.033*	3 (18.8%)	9 (56.2%)	4.8	**0.028***
	YES	10 (62.5%)	6 (37.5%)			12 (75%)	6 (37.5%)			13 (81.2%	7 (43.8%)		
T7	NO	8 (50%)	9 (56.2%)	0.1	0.72	6 (37.5%)	8 (50%)	0.51	0.48	3 (18.8%)	6 (37.5%)	1.39	0.24
	YES	8 (50%)	7 (43.8%)			10 (62.5%)	8 (50%)			13 (81.2%)	10 (62.5%)		
T8	NO	16 (100%)	16 (100%)	-	-	14 (87.5%)	15 (93.8%	0.37	0.54	10 (62.5%)	12 (75%)	0.58	0.45
	YES	0	0			2 (12.5%)	1 (6.2%)			6 (37.5%)	4 (25%)		
T9	NO	10 (62.5%)	9 (56.2%)	0.1	0.72	8 (50%)	7 (43.8%)	0.13	0.72	5 (31.2%)	6 (37.5%)	0.14	0.71
	YES	6 (37.5%)	7 (43.8%)			8 (50%)	9 (56.2%)			11 (68.8%)	10 (62.5%)		
T10	NO	8 (50%)	7 (43.8%)	0.1	0.72	6 (37.5%)	5 (31.2%)	0.14	0.71	4 (25%)	5 (31.2%)	0.16	0.69
	YES	8 (505)	9 (56.2%)			10 (62.5%)	11 (68.8%)			12 (75%)	11 (68.8%)		
T11	NO	4 (25%)	5 (31.2%)	0.2	0.69	3 (18.8%)	5 (31.2%)	0.67	0.41	0	4 (37.5%)	7.39	**0.007***
	YES	12 (75%)	11 (68.8%)			13 (81.2%)	11 (68.8%)			16 (100%)	10 (62.5%)		
T12	NO	5 (31.2%)	7 (43.85%)	0.5	0.47	3 (18.8%)	7 (43.8%)	2.33	0.13	2 (12.5%)	6 (37.5%)	2.67	0.1
	YES	11 (68.8%)	9 (56.2%)			13 (81.2%)	9 (56.2%)			14 (85.5%)	10 (62.5%)		
T13	NO	8 (50%)	8 (50%)	0	1	6 (37.5%)	7 (43.8%)	0.13	0.72	4 (25%)	6 (37.5%)	0.58	0.45
	YES	8 (50%)	8 (50%)			10 (62.5%)	9 (56.2%)			12 (75%)	10 (62.5%)		
T14	NO	9 (56.2%)	10 (62.5%)	0.1	0.72	7 (43.8%)	8 (50%)	0.13	0.72	4 (25%)	7 (43.8%)	1.25	0.26
	YES	7 (43.8%)	6 (37.5%)			9 (56.2%)	8 (50%)			12 (75%)	9 (56.2%)		
T15	NO	10 (62.5%)	12 (75%)	0.6	0.45	8 (50%)	10 (62.5%)	0.51	0.48	6 (37.5%)	10 (62.5%)	2	0.16
	YES	6 (37.5%)	4 (255)			8 (50%)	6 (37.5%)			10 (62.5%)	6 (37.5%)		

*Significant Difference, SD: Standard Deviation, p-value: Probability Value, T1-T15: 15 Items of Sit-to-Stand Movement.

Table 4. Comparison of PBS and Modified Borg Scale between the groups

		Study group (n=16)	Control group (n=16)	p-values		
Variable		**Mean ± SD**	**Mean ± SD**	**Group**	**Group x time**	**Time**
PBS	Baseline	46.25±4.05	47.13±3	0.312	<0.001*	<0.001*
	4 weeks	47.25±4.2	48.63±2.91			
	8 weeks	48.19±4.02	49.81±2.88			
Modified Borg Scale	Baseline	6.56±1.26	6.06±0.92	0.006*	<0.001*	<0.001*
	4 weeks	5.69±1.19	4.5±0.73			
	8 weeks	5±1.09	3.62±0.80			

*Significant Difference, 2×2 Repeated Measures ANOVA was Applied, SD: Standard Deviation; p-value: Probability Value, PBS: Pediatric Balance Scale.

Table 5. Comparison of PBS and Modified Borg Scale at different time intervals in study group

Variable	0 vs. 4 weeks	4 weeks vs. 8 weeks	0 weeks vs. 8 weeks
PBS	<0.001*	<0.001*	<0.001*
Modified Borg Scale	<0.001*	<0.001*	<0.001*

*Significant difference. PBS: Pediatric Balance Scale.

DISCUSSION

Children with CP have severely limited mobility and functional abilities, particularly in the STS and functional balance domains, due to movement and posture disorders. Inability to keep their bodies against gravity without losing balance while performing tasks like the PBS tests may have been caused by neuromotor deficits arising from their brain injuries (23). These children suffer earlier fatigue due to their increased energy needs. Pilates is an exercise programme that enhances the neuromuscular system to control and safeguard the core stability body or spine (24). This study sought to ascertain the effects of pilates on movement patterns, balance, and tiredness in children with spastic CP because the pilates strategy concentrates on core body activity. When completing STS movements, children with CP show higher postural oscillation, showing difficulty assuming the standing position.

After 8 weeks of pilates exercises, differences were observed in almost all of the items in the study group. Moreover, previous research has also suggested that the ability to start the lower limb joint motions required to attain the standing posture improves as a result of pilates exercise program (25). A significant improvement was found in PBS after pilates exercise program in the present study. However, conventional therapy, which included stretching, strengthening, and postural control exercises, also demonstrated positive changes in the balance outcomes in the control group. However, improvements observed in the pilates group were superior than control group. These findings can be explained by the fact that the body's kinematics improved resulting in more efficient motor function after structured pilates intervention. For the purpose of enhancing balance, increasing functional mobility, and controlling extremity movement, the trunk is crucial (26). Pilates exercises offer multitask intervention with improved kinaesthetic and proprioceptive awareness and movement coordination by requiring the practitioner to maintain a stable posture while focussing on the respiratory rhythm (27). Results of the present investigation were consistent with previous studies which also emphasized upon the fact that pilates exercise could help children with CP with their trunk, lower limb strength, and balance (28-31).

Findings of the present study suggested that an eight-weeks pilates training regimen can have a positive impact on fatigue in ambulant children with spastic CP. Children with spastic CP may find their level of exhaustion reduced by engaging in core exercises. These findings are consistent with the findings of Soysal Tomruk et al. (32), which showed that pilates training has the potential to reduce fatigue in patients with multiple sclerosis. Pilates was developed as a low-impact exercise to target and strengthen certain muscle groups without exhausting the entire body. It explains how to engage your back and stomach muscles without putting too much strain on your joints, as well as how to develop your mind-body connection by synchronising your breathing and movement. It is ideal for children with neurological disorders who easily get fatigued. Pilates is a low-impact exercise that enhances muscle balance and neuromuscular processes to achieve maximal strength. Pilates practice leads to an improvement in the ability to stabilize the body and in the ability to produce muscle contraction; as well as promotes increased strength, balance and flexibility. Thus, it seems reasonable to suggest that children with CP who can perform functional activities, such as walking and quiet standing, but need to enhance components required for a controlled movement, such as muscle strength,

joint mobility, flexibility and postural control, could benefit from pilates practice (28).

Limitations

In the present study, there was no long-term follow-up assessment; therefore, more research is required to evaluate long-term effects of pilates exercise on children with spastic CP. The effect of plates on strength and flexibility was not evaluated which was another limitation. This study included only spastic diplegic children, therefore, additional research with varying GMFCS levels should be conducted on various CP subtypes. Though PBS is valid and reliable scale to assess balance, objective measures like biodex balance system could not be used in the study due to unavailability of the equipment.

CONCLUSION

The present study revealed that pilates exercises along with conventional exercises plays an important role in improving movement pattern, balance and decreasing fatigue which are important clinical parameters for children with spastic CP. Therefore, pilates exercises could be considered as an adjunct exercise program in children with spastic CP.

Ethics: Ethical clearance was obtained from Departmental Ethics Committee, Faculty of Physiotherapy, *Shree Guru Gobind Singh Tricentenary* University, Gurugram, before recruiting subjects (proposal ID: SGTU/FPHY/2022/421, approval date: 12 October 2022, meeting held on 8 October 2022).

Informed Consent: The subjects' parents were explained about the nature and procedures of the study and a written assent was obtained from them for participation of their ward into the study.

Sources of Support: None.

Conflict of Interest: The authors declare that there is no conflict of interest.

Author Contributions: Concept- AD; Design- AG; Supervision- AG; Resources and Financial Support- AG; Materials- AD; Data Collection and/or Processing- AD; Analysis and/or Interpretation- AG, PB, VC; Literature Search- AD; Writing Manuscript- AG; Critical Review- VC, PB.

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REFERENCES

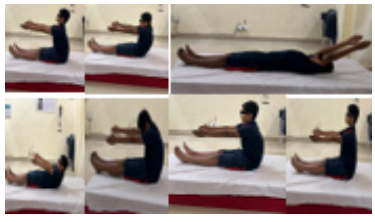
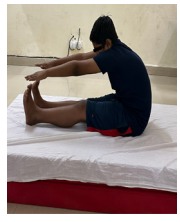
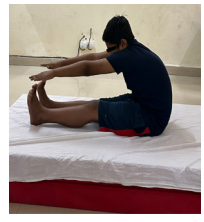
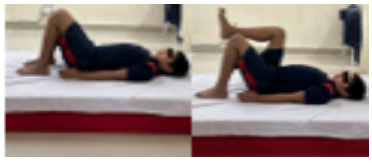
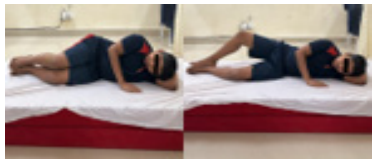
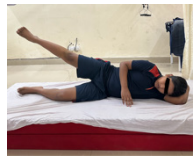
1. Levitt S, Addison A. Treatment of cerebral palsy and motor delay. John Wiley & Sons; 2018 Nov 28.
2. Vitrikas K, Dalton H, Breish D. Cerebral palsy: an overview. Am Fam Physician. 2020;101(4):213-20.
3. Da Costa CS, Rocha NA. Sit-to-stand movement in children: a longitudinal study based on kinematics data. Hum Mov Sci. 2013;32(4):836-46.
4. Suriyaamarit D, Boonyong S. Mechanical work, kinematics, and kinetics during sit-to-stand in children with and without spastic diplegic cerebral palsy. Gait Posture. 2019;67:85-90.
5. Pavão SL, Santos AN, Oliveira AB, Rocha NA. Postural control during sit-to-stand movement and its relationship with upright position in children with hemiplegic spastic cerebral palsy and in typically developing children. Braz J Phys Ther. 2015;19(1):18-25.
6. Gupta A, Sen S. The effect of pelvic control exercises on standing posture in children with spastic diplegic cerebral palsy: a pilot randomized controlled trial. Turk J Physiother Rehabil. 2025;36:20-40.
7. Balemans AC, van Wely L, Becher JG, Dallmeijer AJ. Longitudinal relationship among physical fitness, walking-related physical activity, and fatigue in children with cerebral palsy. Physical Therapy. 2015;95(7):996-1005.
8. Tarakci D, Ozdincler AR, Tarakci E, Tutuncuoglu F, Ozmen M. Wii-based balance therapy to improve balance function of children with cerebral palsy: a pilot study. J Phys Ther Sci. 2013;25(9):1123-7.
9. Lowes LP, Westcott SL, Palisano RJ, Effgen SK, Orlin MN. Muscle force and range of motion as predictors of standing balance in children with cerebral palsy. Phys Occup Ther Pediatr. 2004;24(1-2):57-77.
10. Hornsby E, Johnston LM. Effect of pilates intervention on physical function of children and youth: a systematic review. Arch Phys Med Rehabil. 2020;101(2):317-28.
11. O'Shea R, Siconolfi-Morris G. Complementary therapy approaches for children and youth with cerebral palsy. Cerebral Palsy. 2020:3069-81.
12. Dos Santos AN, Serikawa SS, Rocha NA. Pilates improves lower limbs strength and postural control during quite standing in a child with hemiparetic cerebral palsy: A case report study. Dev Neurorehabil. 2016;19(4):226-30.
13. Schmidt SA, Lo S, Hollestein LM. Research techniques made simple: sample size estimation and power calculation. J Invest Dermatol. 2018;138(8):1678-82.
14. Ghotbi N, Nakhostin Ansari N, Naghdi S, Hasson S. Measurement of lower-limb muscle spasticity: intrarater reliability of Modified Modified Ashworth Scale. J Rehabil Res Dev. 2011;48(1):83-8.
15. Palisano RJ, Avery L, Gorter JW, Galuppi B, McCoy SW. Stability of the Gross Motor Function Classification System, Manual Ability Classification System, and Communication Function Classification System. Dev Med Child Neurol. 2018;60(10):1026-32.
16. Yonetsu R, Nitta O, Surya J. "Patternizing" standards of sit-to-stand movements with support in cerebral palsy. NeuroRehabilitation. 2009;25(4):289-96.
17. Nuzik S, Lamb R, VanSant A, Hirt S. Sit-to-stand movement pattern. A kinematic study. Phys Ther. 1986;66(11):1708-13.
18. Park ES, Park CI, Lee HJ, Kim DY, Lee DS, Cho SR. The characteristics of sit-to-stand transfer in young children with spastic cerebral palsy based on kinematic and kinetic data. Gait Posture. 2003;17(1):43-9.
19. Chen CL, Shen IH, Chen CY, Wu CY, Liu WY, Chung CY. Validity, responsiveness, minimal detectable change, and minimal clinically important change of Pediatric Balance Scale in children with cerebral palsy. Res Dev Disabil. 2013;34(3):916-22.
20. Maltais D, Wilk B, Unnithan V, Bar-Or O. Responses of children with cerebral palsy to treadmill walking exercise in the heat. Med Sci Sports Exerc. 2004;36(10):1674-81.

21. Robert M, Ballaz L, Hart R, Lemay M. Exercise intensity levels in children with cerebral palsy while playing with an active video game console. Phys Ther. 2013;93(8):1084-91.
22. Gutner K. The Pilates essential repertoire. Art of motion, 19 edition. 2013:96-208.
23. Pavão SL, Dos Santos AN, de Oliveira AB, Rocha NA. Functionality level and its relation to postural control during sitting-to-stand movement in children with cerebral palsy. Res Dev Disabil. 2014;35(2):506-11.
24. Phrompaet S, Paungmali A, Pirunsan U, Sitilertpisan P. Effects of pilates training on lumbo-pelvic stability and flexibility. Asian J Sports Med. 2011;2(1):16-22.
25. Niaradi FDSL, Niaradi MFDSL, Gasparetto MERF. Effect of eutonia, holistic gymnastics, and pilates on body posture for pre-adolescent girls: randomized clinical trial. J Bodyw Mov Ther. 2022;30:226-36.
26. Panibatla S, Kumar V, Narayan A. Relationship between trunk control and balance in children with spastic cerebral palsy: a cross-sectional study. J Clin Diagn Res. 2017;11(9):YC05-8.
27. Suner-Keklik S, Numanoglu-Akbas A, Cobanoglu G, Kafa N, Guzel NA. An online pilates exercise program is effective on proprioception and core muscle endurance in a randomized controlled trial. Ir J Med Sci. 2022;191(5):2133-9.
28. Dos Santos AN, Serikawa SS, Rocha NA. Pilates improves lower limbs strength and postural control during quite standing in a child with hemiparetic cerebral palsy: A case report study. Dev Neurorehabil. 2016;19(4):226-30.
29. Adıguzel H, Elbasan B. Effects of modified pilates on trunk, postural control, gait and balance in children with cerebral palsy: a single-blinded randomized controlled study. Acta Neurol Bel. 2022;122(4):903-14.
30. Abd-Elfattah HM, Galal DOSM, Aly MIE, Aly SM, Elnegamy TE. Effect of pilates exercises on standing, walking, and balance in children with diplegic cerebral palsy. Ann Rehabil Med. 2022;46(1):45-52.
31. Değer Ü, Mutlu A. An investigation of relationship between trunk and lower extremity muscle strength and functional activity in children with spastic cerebral palsy. Turk J Physiother Rehabil. 2020;31(3):225-32.
32. Soysal Tomruk M, Uz MZ, Kara B, İdiman E. Effects of pilates exercises on sensory interaction, postural control and fatigue in patients with multiple sclerosis. Mult Scler Relat Disord. 2016;7:70-3.

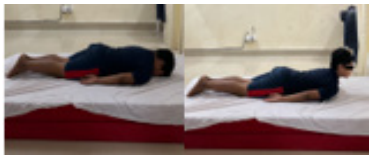
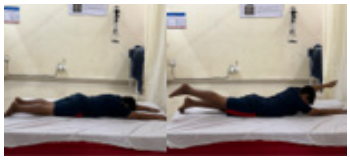
Appendix 1. Pilates programme

	0-4 weeks	4-6 weeks	6-8 weeks
Bow and arrow	In standing, outstretched the arms in front at chest height. Allow the right scapula to slightly protract as you extend your right arm forward. The scapula protraction starts the thoracic rotation. Exhale and continue segmentally rotating the left side of the thoracic spine while bending the left elbow back diagonally. Repeat the exercise 5 times each side.	High kneeling can be used to perform the exercise.	The exercise can be done while seated.
			
Knee lift and aeroplane	In standing, outstretched the arms in front at chest height. The heel is raised off the ground. Raise the knee. The pelvis is dynamically stabilised. The spine is neutral and long. Toes should just barely contact the ground when you bring the unsupported leg down. Repeat the exercise 5 times each side.	For a few breaths, continue to lift the unsupported leg.	The supported leg should bend and extend.
			
Arm and leg lift	In quadruped position, one of the leg is extended back. The floor is softly touched by the toes. Lift the leg until the hip joint is fully stretched. In a neutral position, the lumbar spine and pelvis are stabilised. Bring that leg down. Repeat the exercise 5 times each side.	Lift one arm while maintaining shoulder blade stability.	Lift the right leg off the ground while sliding it backward until the hip joint is stretched. Lift the left arm at the same time.
			

Appendix 1. Continued

	0-4 weeks	4-6 weeks	6-8 weeks
Shoulder separation	The arms are elevated in front of the body at chest height. The hands are stacked one on top of the other, left hand in front of right. Raise the right arm diagonally up while bringing the left arm down. Five times on each side, repeat the exercise.	The arms should be raised and lowered vertically.	Include swinging your arms in a semicircle.
			
Roll up	At chest height, the front arms are outstretched. Segmentally flex the spine beginning at the lower lumbar spine, engage the centre, and tilt the pelvis back. Roll each vertebra down one at a time untill the shoulders and head are on the floor. Reach the arms overhead while maintaining the front ribs in place. Lift the head and shoulders off the floor while circling the arms in front of you. Roll up while peeling each vertebra off the mat one at a time in a segmental motion. Turn your legs over and stretch your spine forward. Thoracic spine extension should be done in segments until neutral alignment is restored.	Knees should be bent while you sit. Roll down while leaving the heels in place to allow the legs to expand freely.	Dorsiflexion is added when you roll into leg stretch.
			
Leg float	In supine lying, lift one leg such that it forms a 90° angle at the hip and knee. Lower the leg and roll the foot down. 5-6 times on each side, alternating sides or only right, then left, repeat the exercise.	Alternating leg float	A simple leg floating with a ball
			
Pelvic curl	In supine lying, bend your knees and lift your buttocks off the plinth. Five to ten times should be enough to complete the exercise.	With arms behind head, pelvis curl	Knee squeezes and pelvic curl
			
Clam	In sidelying, knees are 90 degrees bent; lift the top knee and rotate the hip joint to the side. The large toes remain joined. Leg is lowered. 10 times total should be repeated.	Keep your upper thigh in line and straighten your knee.	With one hand on the sacrum, stabilise the pelvis and tilt the pelvis in the transversal plane slightly to the front.
			

Appendix 1. Continued

	0-4 weeks	4-6 weeks	6-8 weeks
Dart	Lift the head and shoulders up while lying prone and keep the palms facing up. Maintain a relaxed or slightly raised arm position.	With the palms down, rotate the arms laterally. Inhale With the palms facing up, rotate the arms medially.	Raise your arms and extend the small fingers.
			
Alternate arm and leg lift	Raise the left leg and right arm while lying prone. On each side, perform the exercise 5 to 6 times.	When lifting, rotate your upper arm laterally. The thumb is pointing up.	simultaneously raise your arms and legs off the ground.
			

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THE EFFECTIVENESS OF INTERFERENTIAL CURRENT THERAPY ON SALIVARY GLAND FUNCTION IN INDIVIDUALS WITH PRIMARY SJOGREN'S SYNDROME: SINGLE-BLIND RANDOMIZED, CONTROLLED TRIAL

ABSTRACT

Purpose: This study aimed to investigate short-, mid-, and long-term effects of interferential current (IFC) therapy combined with clinical Pilates exercises (CPE) in primary Sjogren's syndrome (pSS).

Methods: Thirty-six pSS were included. The participants were randomly divided into 2 groups [intervention group (active IFC therapy + CPE) n=18; control group (sham IFC therapy + CPE) n=18]. Unstimulated salivary flow rate measurement (unstimulated SFRM); Stimulated salivary flow rate measurement (stimulated SFRM); health assessment questionnaire (HAQ); Oral Health Impact Profile-14 (OHIP-14); oral health-related quality of life-United Kingdom questionnaire (OHRQOL-UK); Beck Depression Inventory (BDI); Beck Anxiety Inventory (BAI); short form-36 (SF-36), Pittsburgh Sleep Quality Index (PSQI) were used for evaluation. Assessments were conducted pre-treatment and at 8, 20, 32, and 44 weeks post-treatment. Both treatments were applied 3 times weekly for 8 weeks.

Results: When the pre- and post-treatment data were compared, improvement was observed in unstimulated SFRM and Stimulated SFRM values in the intervention group ($p<0.001$). The improvements were also recorded in HAQ, OHIP-14, OHRQOL-UK, BDI, BAI, SF-36 (physical and mental component), and PSQI in both groups ($p<0.05$). When the difference values of all parameters were compared post treatment, they were significant in favor of intervention group ($p<0.05$). Analysis of stimulated and unstimulated SFRM, HAQ, OHIP-14, OHRQOL-UK, BDI, BAI, SF-36, and PSQI revealed significant group and time-by-group interaction effects ($p<0.05$).

Conclusion: IFC therapy is an effective non-pharmacological treatment method that can be safely applied in the short-term, med-, and long-term in disease activity and symptoms. CPE contribute positively to the improvement of psychosocial factors in pSS.

Keywords: Exercise, Interferential current, Saliva, Sjogren's syndrome, Xerostomia

PRİMER SJÖGREN SENDROMLU BİREYLERDE İNTERFERANSİYEL AKIM TEDAVİSİNİN TÜKÜRÜK BEZİ FONKSİYONU ÜZERİNDEKİ ETKİNLİĞİ: TEK KÖR, RANDOMİZE, KONTROLLÜ ÇALIŞMA

ÖZ

Amaç: Bu çalışma, interferans akımı (İFA) tedavisinin klinik Pilates egzersizleri (KPE) ile birlikte uygulanmasının primer Sjögren sendromu'nda (pSS) kısa, orta ve uzun vadeli etkilerini araştırmayı amaçladı.

Yöntem: Çalışmaya 36 pSS hastası dahil edildi. Katılımcılar rastgele iki gruba ayrıldı [müdahale grubu (aktif İFA tedavisi + KPE) n=18; kontrol grubu (sham İFA tedavisi + KPE) n=18]. Uyarılmamış tükürük akış hızı ölçümü (uyarılmamış TAHÖ), uyarılmış tükürük akış hızı ölçümü (uyarılmış TAHÖ), sağlık değerlendirme anketi (SDA), ağız sağlığı etki profili-14 (ASEP-14), ağız sağlığıyla ilgili yaşam kalitesi-Birleşik Krallık anketi (ASYK-BK), Beck Depresyon Envanteri (BDE), Beck Anksiyete Envanteri (BAE), kısa form-36 (KF-36) ve Pittsburgh Uyku Kalitesi İndeksi (PUKİ) değerlendirme için kullanıldı. Değerlendirmeler tedavi öncesinde ve tedaviden sonra 8., 20., 32. ve 44. haftalarda yapıldı. Her iki tedavi de 8 hafta boyunca haftada 3 kez uygulandı.

Bulgular: Tedavi öncesi ve sonrası veriler karşılaştırıldığında, müdahale grubunda uyarılmamış ve uyarılmış TAHÖ değerlerinde iyileşme gözlendi ($p<0,001$). Her iki grupta da SDA, ASEP-14, ASYK-BK, BDE, BAE, KF-36 (fiziksel ve zihinsel bileşenler) ve PUKİ'de iyileşmeler kaydedildi ($p<0,05$). Tüm parametrelerin tedavi sonrası fark değerleri karşılaştırıldığında, sonuçlar müdahale grubu lehine anlamlıydı ($p<0,05$). Uyarılmış ve uyarılmamış TAHÖ, SDA, ASEP-14, ASYK-BK, BDE, BAE, KF-36 ve PUKİ analizlerinde, grup ve zaman-grup etkileşim etkileri anlamlı bulundu ($p<0,05$).

Sonuç: İFA tedavisi, hastalık aktivitesi ve semptomlarda kısa, orta ve uzun vadede güvenle uygulanabilecek etkili bir farmakolojik olmayan tedavi yöntemidir. KPE ise pSS'de psikososyal faktörlerin iyileşmesine olumlu katkı sağlamaktadır.

Anahtar Kelimeler: Egzersiz, İnterferansiyel akım, Tükürük, Sjögren sendromu, Kserostomi

INTRODUCTION

Primary Sjogren syndrome (pSS) is an autoimmune disease characterized by lymphocytic infiltration of all exocrine glands, mainly the lacrimal and salivary glands, secondary to a local inflammatory reaction (1). pSS is a systemic autoimmune disease most commonly diagnosed in women between the fifth and seventh decades of life (2). The main clinical features of pSS involve the lacrimal and salivary glands, while the sicca syndrome complex, which includes xerophthalmia and xerostomia as well as recurrent salivary gland enlargement, is part of these clinical features. However, approximately one-third to one-half of patients with pSS experience extra-glandular symptoms (3).

The management of pSS is usually aims to reduce mouth and eye dryness, and improve fatigue and functionality. A multidisciplinary approach is often recommended, with a combination of non-pharmacological and pharmacological treatments depending on the symptoms. In addition, emphasis was placed on exercise and electrotherapy as non-pharmacological treatment methods (1).

Salivation is regulated by the autonomic nervous system. The sublinguinal glands and submandibular are innervated by sympathetic nerve fibers and facial parasympathetic nerves (4). Branches of the facial nerve are located in the submandibular area. For this reason, facial nerves that innervate the salivary glands can be stimulated by interferential current (IFC) therapy to stimulate salivary secretion (5). Since IFC therapy is an alternating medium frequency current, it encounters less skin resistance, does not lead to pain or discomfort and contributes to the treatment of deep tissues (6). To inform the task force responsible for the 2019 EULAR recommendations for the management of dry mouth in patients with SS, electrical stimulation is included in non-pharmacological approaches (1). Research has demonstrated that electrical stimulation, a therapeutic approach for treating dry mouth effectively activates saliva, however, despite its advantages, it is remarkable that the use of IFC therapy is limited (7,8).

Many patients with pSS have musculoskeletal complaints. In 30% of patients, sicca symptoms occur before them (9). One of the most common extraglandular symptoms of pSS is extreme fatigue. More than 50% of patients with pSS experience severe and debilitating fatigue that leads to a reduced quality of life. This leads to a sedentary lifestyle (10). At the same time, the decrease in sleep quality of patients with pSS negatively affects fatigue and pain symptoms. The increase in sleep quality obtained with non-pharmacological treatment adapted for insomnia can positively affect other symptoms and improve sleep and daytime participation of the individual (11).

Although it is known that exercise is important in individuals with pSS, there are a few studies indicating that it is a low-cost, safe and effective treatment intervention. The short-term positive effects of exercise on physical performance and pain in individuals with pSS have been reported (12). Exercise has also been shown to be effective in reducing fatigue and improving quality of life, mood and other psychological aspects (1). To inform the task force responsible for the 2023 EULAR recommendations for the management of fatigue in individuals with SS, physica activity or exercise and psychoeducational interventions are efficacious and safe (10).

Pilates is a method that includes stretching and strengthening exercises with controlled and precise movements, developed by Joseph H. Pilates. This method, in the early 2000s, adapted to the clinic by Australian physiotherapists, can be used under the name of “clinical Pilates” in both healthy individuals and various patient groups. The 6 basic principles of the clinical Pilates method- centering, concentration, control, precision, breath and flow. This method, which aims to improve body functions, includes function-oriented trunk stabilization exercises. These exercises combined with breathing ensure smooth movement (13).

Although some studies emphasize that IFC therapy is an effective method in reducing symptoms related to dry mouth. There is a lack of information regarding its effects on the treatment of individuals with pSS and the appropriate duration and frequency required for treatment. On the other hand, despite being highly recommended and widely known, there is also a lack of information regarding studies evaluating the effects of clinical Pilates on the biopsychosocial functions of individuals with pSS. Therefore, the main objective of this study is to investigate the short-, mid-, and long-term effects of IFC therapy combined with clinical Pilates exercises on salivary gland and biopsychosocial functions of individuals with pSS. Our first hypothesis is that IFC therapy improves salivary functions in individuals with pSS. The second hypothesis is that clinical Pilates exercises in individuals with pSS have an effect on at least one of the following: disease activity, anxiety, depression, quality of life and sleep quality.

METHOD

Study Design

In the present study, the stages of the guidelines of the Consolidated Standards of Reporting Trials (CONSORTs) were followed and was planned as a prospective, two-arm, randomized, controlled, single-blind, parallel group. Data collection was performed between January and November 2019 at Pamukkale University Hospital. This study was approved by the Pamukkale University Ethics Committee

for Non-Interventional Clinical Research (approval number: 60116787-020/90548, date: 12.31.2018). All participants were informed in advance about the procedures and assessments to be performed in the study. Those who agreed to participate signed consent forms. The study was registered retrospectively at ClinicalTrials.gov (registration number: NCT06989411). The methods of this study were reported using the CONSORT statement.

Participants

Recruitment and Setting

A total of 36 volunteers with pSS [female 32 (88.9%)/male 4 (11.1%)], (mean age, 49.66±9.68 years) were included in the study. pSS was diagnosed by the same rheumatologist in those who met the American College of Rheumatology 2016 criteria. Then the rheumatologist referred the patients to a physical therapist at the rheumatologic physiotherapy and rehabilitation clinic. Data collection was performed between January and November 2019 at Pamukkale University Hospital. Participants arriving at the hospital were screened for inclusion and exclusion criteria by one of the researchers (V.C., rheumatologist). The intervention group had 18 participants [female 16 (88.9%)/male 2 (11.1%)], (mean age, 49.50±10.19 years) and the control group had 18 participants [female 16 (88.9%)/male 2 (11.1%)], (mean age, 49.83±9.43 years).

Demographic data of the participants were recorded before the evaluations. Demographic data are shown in Table 1.

The inclusion criteria were: (a) to be diagnosed with pSS according to the 2016 European League Against Rheumatism American/College of Rheumatology Classification Criteria, (b) to be in the 3rd and 4th grade according to the Chisholm-Mason Grading system, (c) be in the age range of 25-65 years, (e) to be stable on drug use for at least 3 months or longer, (f) To have agreed to participate in the study.

The exclusion criteria were as follows: (a) to use antipsychotic, antidepressant, antihypertensive, medical agent for Parkinson's, (b) presence of viral infection, (c) presence of diabetes mellitus, (d) receiving head and neck radiotherapy/chemotherapy, (e) having a head and neck malignancy, (f) having undergone head and neck surgery, (g) presence of dehydration, (h) pregnancy, (i) using cigarettes and alcohol, (j) cognitive problems that affect cooperation, (k) having any other disease that may affect their functions.

Study Procedures

After randomization into the two study groups, the participants were evaluated by a blinded researcher (B.B.C.), then underwent 8 weeks of treatment with a different researcher (A.K.). They were reevaluated by the same blinded researcher (B.B.C.) at 8th weeks and again at 20th, at 32nd, and at 44th weeks. Study phases and arms were defined as follows: intervention group: participants received active IFC therapy + clinical Pilates exercises and control group: participants received sham IFC therapy + clinical Pilates exercises.

Intervention

IFC were applied in 2 different methods [intervention group (active IFC therapy)]; control group [sham IFC therapy)] and clinical Pilates exercises were performed both groups by a certified and experienced physiotherapist 3 times a week for 8 weeks. When participants could not attend the sessions for

Table 1. Demographic and disease-related data of the patients

	Intervention group (n=18) M ± SD	Control group (n=18) M ± SD	p
Age (years)	49.50±10.19	49.83±9.43	**0.919***
Height (cm)	160.55±7.42	159±8.81	**0.571***
Body weight (kg)	72.02±13.44	73.13±12.77	**0.801***
BMI (kg/m^2)	27.79±3.83	28.95±4.56	**0.420****
Period of study (years)	9.61±4.46	8.94±4.55	**0.639****
Duration of disease (months)	88.00±63.76	105.33±58.28	**0.401***
	n (%)	n (%)	
Gender female/male	16 (88.90)/2 (11.10)	16 (88.90)/2 (11.10)	1.000‡
Family history of rheumatic disease yes/no	9 (50)/9 (50)	10 (55.4)/8 (44.6)	0.931‡
Chisholm-Mason Grading system grade 3/grade 4	13 (72.2)/5 (27.8)	14 (77.8)/4 (22.2)	0.700‡

*Independent Samples t-test, **Mann-Whithney U Test, ‡Chi Squared Test, M: Mean, SD: Standard Deviation, BMI: Body Mass Index.

various reasons for eight weeks, one additional session was given as compensation. Participants who could not attend more than one session were excluded from the study.

For two groups, total treatment session was approximately 60 minutes. Firstly, IFC therapy was applied for 12 minutes. Then, clinical Pilates exercises were applied for 45 minutes. Three minutes was the preparation of the patients.

All participants in the intervention group and the control group was given a private session time and their meetings were prevented.

Interferential Current Therapy

After the first evaluation, the participants were informed about the application and effectiveness of the interfering current, feeling during application, and the absence of any pain or discomfort during electrical stimulation. IFC therapy was applied for 12 minutes. Before the IFC therapy, participants rested for 5 minutes. Then, the participants were made to take a relaxed position in the supine position with support from appropriate body parts. The electrodes were placed crosswise to cover the submandibular and sublingual regions, and were prepared for the application of 2 channels and 4 electrodes (Figure 1). Since the optimal beat frequency for saliva secretion has not been clarified in the literature, we accepted 50Hz as the frequency difference (5).

For intervention group (active IFC therapy), the current intensity was determined as the mA CC level that the participant felt at the maximum but did not feel any discomfort. For control group (sham IFC therapy), the current intensity was set to 0.1 mA CC (necessary for the machine to work).

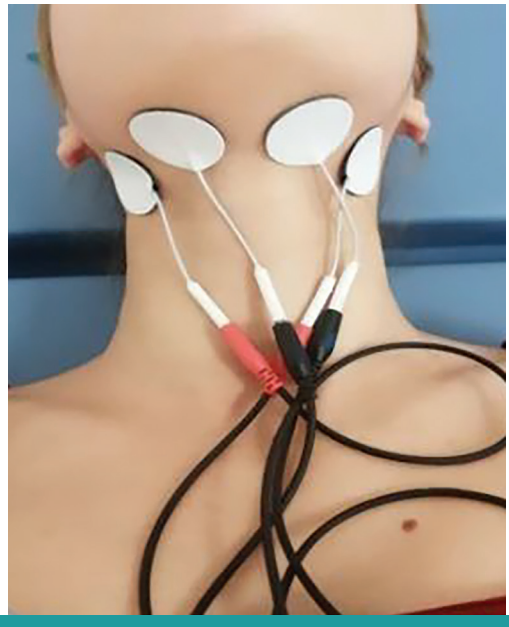

Figure 1. The electrodes application of 2 channels and 4 electrodes.

For two groups, Vector Scan Auto is set to 100%, Lower frequency is 1Hz, upper frequency is 49Hz, carrier frequency is 2500Hz and sweep is on.

Clinical Pilates Exercises

The same Pilates exercises were applied to both groups. Before starting the clinical Pilates exercise program, 5 key elements of clinical Pilates exercises were taught to all the participants (breathing; focus; placement of the rib cage, shoulder, head, and neck). Participants were encouraged to use these 5 key elements not only during exercise but also in their daily lives and during physical activity. The exercises were repeated during the clinical Pilates sessions until the participants achieved the correct posture according to the 5 key elements. The physiotherapist first demonstrated all the exercises and then the participants were asked to do the exercises correctly. The purpose of each exercise is explained so that the exercises can be functional in daily life. Each exercise was performed for 8-10 repetitions. Progression of exercise sessions, increasing the number of repetitions and advancing the exercise level were applied to all participants as standard in 2-week periods. During this progression, the physiotherapist continued the training by showing modifications to participants who had difficulty performing the exercises. All participants attended 45-min same clinical Pilates exercise program (5-min warm up, 35-min functional exercises focused on trunk stabilization, and 5-min cool down) three times a week for 8 weeks which was progressively challenged. Exercise program was shown in Figure 2.

Outcomes

Data regarding the participants' age, height, body weight, body mass index (BMI) and duration of symptoms were recorded on a previously prepared assessment form in face-to-face interviews. Determine the insufficiency of the salivary glands [salivary flow rate measurement-(SFRM)]; health status [health assessment questionnaire-(HAQ)]; quality of life related to oral and dental health [Oral Health Impact Profile-14, (OHIP-14)], and [oral health-related quality of life-United Kingdom questionnaire-(OHRQOL-UK)]; emotional status [Beck Depression Inventory-(BDI)], and [Beck Anxiety Inventory-(BAI)], quality of life Short Form-36, (SF-36)], and sleep quality [(Pittsburgh Sleep Quality Index-(PSQI)] were used for evaluation. All assessments were repeated before treatment, at 8th weeks, and again at 20th, at 32nd, and at 44th weeks by the same physiotherapist (B.B.C.) who was blind to the interventions. Stimulated and unstimulated salivary flow rate was the primary outcome measure, whereas health status, oral health-related quality of life (OHRQOL) quality of life, depression, anxiety, general quality of life, and sleep quality were the secondary outcome measurements.

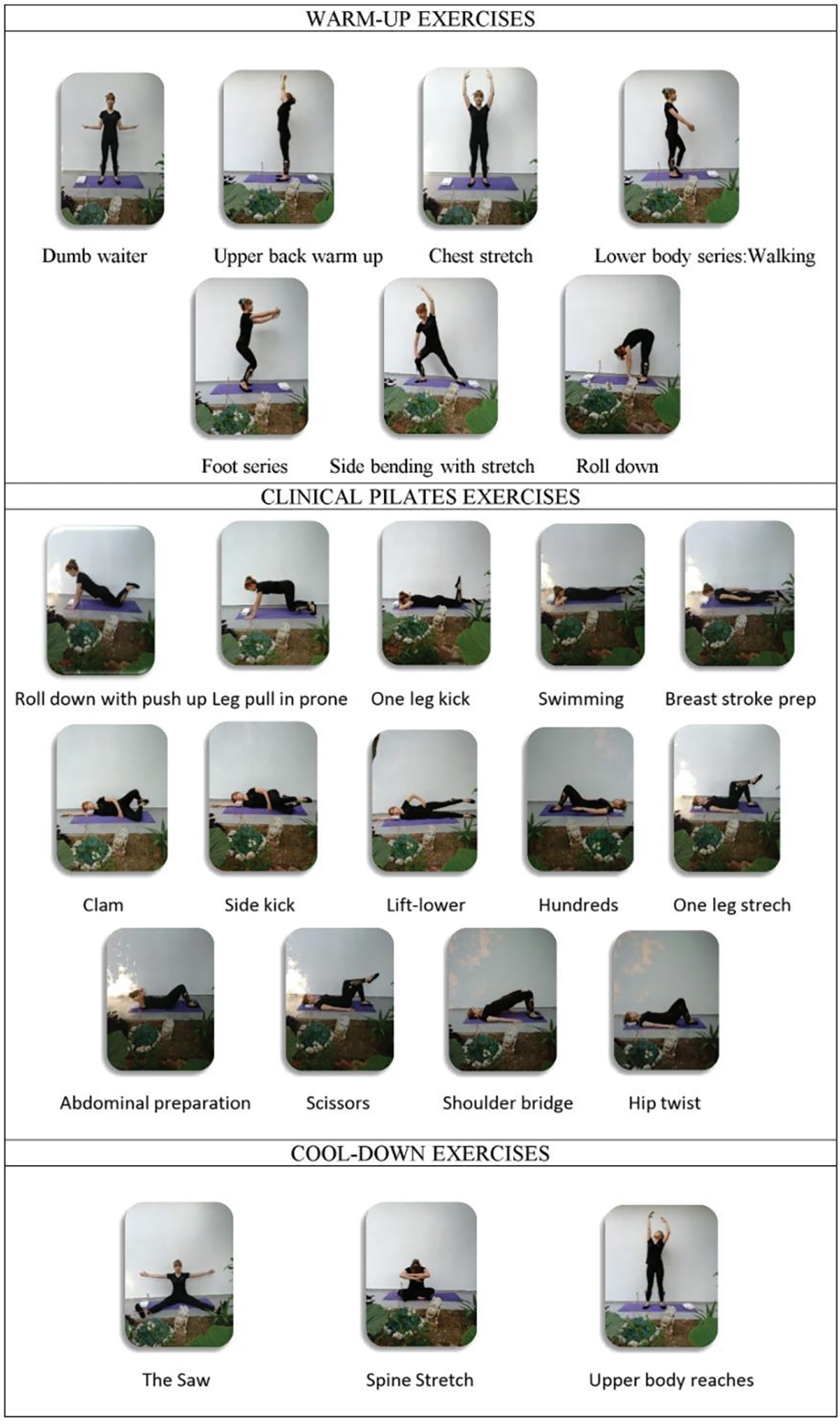

Figure 2. Exercise program (6).

Salivary Flow Rate Measurement: This method used to determine the insufficiency of the salivary glands. In this study, SFRM were made in a quiet laboratory environment between 09:00 and 11:00 without eating or drinking anything, brushing their teeth and chewing gum for 2 hours, without any stress. In order to calculate unstimulated or stimulated salivary flow rate, participants were rested in a sitting position for 5 minutes before the measurement. The participants who rinsed their mouths with water were asked to produce saliva for 10 minutes in sterile container, which were previously tared, in a quiet environment. The unstimulated or stimulated salivary flow rate was obtained by subtracting the tare of the container from the score obtained as a result of the measurement made with a precision balance and was recorded in mL/min. Before measuring the stimulated salivary flow rate, the anterior 1/3 of the tongue of the participant was stimulated drop by drop with 2% citric acid prepared by the chemist. Participants were asked to produce saliva for 10 minutes into the sterile container with the tare measured (14).

Health Assessment Questionnaire: There are 8 subscales and a total of 20 items in which the last 1 week is questioned in order to evaluate the health status of adults with arthritis. The highest score of each subscale constitutes the score of that subscale (15). The Turkish validity and reliability studies of the scale were conducted by Küçükdeveci et al. (16).

Oral Health Impact Profile-14: This is a specific scale developed to comprehensively evaluate the effects of an individual's current oral and dental health on quality of life and general health. It has 14 questions consisting of 7 dimensions. A high score indicates that the quality of life related to oral and dental health decreases (17). The Turkish validity and reliability study of the scale was conducted by Başoğlu et al. (18) and the internal consistency coefficient (Cronbach alpha) value was observed as 0.74.

Oral Health-Related Quality of Life-United Kingdom Questionnaire: OHRQOL-UK is based on the World Health Organization's "structure-function-ability-participation" model, which was revised in 1998, focusing on both disease and health states (negative and positive). It consists of 16 items evaluated on 4 subscales: symptom, physical condition, psychological state, and social situation. A 5-point likert system is used for scoring. A high score indicates that the quality of life related to oral and dental health is high (19). The Turkish validity and reliability study of the scale was conducted by Mumcu et al. (20) and the internal consistency coefficient (Cronbach's alpha) value was observed as 0.96.

Beck Depression Inventory: This inventory consists of 21 items, is scored in a 4-point likert type to evaluate the depression of individuals. High score means high depression (21). The Turkish validity and reliability study of the scale was conducted by Hisli (22).

Beck Anxiety Inventory: BAI was developed to determine the frequency of anxiety symptoms experienced by individuals. A total of 21 items are scored in a 4-point likert type (severe=3, moderate=2, mild=1, never=0). A high score indicates a high level of anxiety (23). The Turkish validity and reliability study of the scale was conducted by Ulusoy et al. (24).

Short Form-36: SF-36 assess health-related quality of life or health status, with total 36 items and eight subscales (general health perception, social functionality, physical functionality, emotional role restrictions, physical role restrictions, mental health, pain, and energy/vitality). Each subscale has a score between 0 and 100, and a high score means the good quality of life. The Turkish validity and reliability study of the scale was conducted by Koçyiğit et al. (25).

Pittsburgh Sleep Quality Index (PSQI): There are a total of 7 subscales to evaluate sleep quality (subjective sleep latency, sleep quality, habitual sleep efficiency, sleep duration, sleep disturbance, daytime dysfunction, and use of sleeping pills). All item is scored between 0-3 points and high scores indicate poor sleep quality (26). The Turkish validity and reliability study of the scale was conducted by Ağargün et al. (27).

Sample Size

Power analysis was performed using the G-Power V.3.1.9.6 (University of Kiel, Kiel, Germany) program to determine the sample size of the study. In the power analysis based on the dry mouth group data of the reference article (5), it was calculated that 80% power with 5% type 1 error level could be obtained with total 34 patients (17 patienst for each group) (d=0.91 effect size).

Randomisation

The random allocation sequence was generated using IBM Statistical Package for the Social Sciences version 22 (IBM SPSS Corp.; Armonk, NY, USA) in charge of allocation. Stratified randomization technic is used. This method was gradually made in such a way that each group had its own subgroup.

Blinding

The principal investigator was not involved in the treatment sessions of the participants and was blinded to group allocation while making the assessments and plotting the data. The participants were asked not to reany information about group allocation to the principal investigator (B.B.C.) performing the assessments.

Statistical Analysis

At the end of the study, the data were analyzed using the IBM Statistical Package for the Social Sciences version 20.0 (IBM

SPSS Corp.; Armonk, NY, USA). The Kolmogorov-Smirnov test was used to determine whether the continuous variables were normal distributions. Means and standard deviations were used for continuous variables, and numbers and percentages for categorical variables. The Independent samples test, Mann-Whitney U test and Chi-Squared test were used to compare demographic and disease-related data between groups, depending on whether the data were normally distributed or not. Baseline values of all assessed parameters were compared between groups using one-way ANOVA. A mixed-model repeated measures ANOVA was used to analyze changes in saliva flow rate, health status, OHRQOL, depression, anxiety, quality of life and sleep quality in the intervention and control groups. A p-value <0.05 was accepted significant. Partial eta-squared (η^2) calculated by SPSS, was used to gauge effect size (over 0.14=large effect size 0.06=medium effect size, less than 0.01=small effect size) (28).

RESULTS

A total of 54 volunteers who met the inclusion criteria were randomly divided into 2 groups; the intervention group (n=27) and the control group (n=27) with SPSS 22.0 package program. In the intervention group, 7 participants left the training because they could not get permission from work and 2 participants could not continue the program because she started work after starting treatment. In the control group, 9 participants left the training because they could not get permission from work and did not continue the program regularly, thus all these participants' data were excluded. This study was completed with a total of 36 participants; 18 individuals with pSS [female 16 (88.9%)/male 2 (11.1%)], (mean age, 49.50±10.19 years) in the intervention group and 18 individuals with pSS [female 16 (88.9%)/male 2 (11.1%)], (mean age 49.83±9.43 years) in the control group. Figure 3 shows a flowchart of the study design. There were no adverse events reported with the program. The rate of participation in the treatment sessions was 100%. Age, sex, height, body weight, BMI, period of study (years), duration of disease (months), family history of rheumatic disease, and Chisholm-Mason Grading system grade are shown in Table 1. No significant differences were detected between the groups in terms of age (p=0.919), height (p=0.571), body weight (p=0.801), BMI (p=0.420), duration of pSS (p=0.401), family history of rheumatic disease (p=0.931), and Chisholm-Mason Grading system grade (p=0.700).

Recruitment

The dates determining the recruitment periods were 01.14.2019-11.20.2019. Volunteers were selected from individuals with pSS who applied to the rheumatology clinic of the the university hospital and met the inclusion and exclusion criteria. At the first interview with the participants, they were asked whether they volunteered to participate in the study. An appointment was made for another day in order to evaluate the volunteers.

Primary Outcome Measure

Statistically significant improvement was observed in unstimulated SFRM (mL/min) and Stimulated SFRM (mL/min) in the intervention group when pre- and post-treatment outcomes were compared (p<0.001, p<0.001, respectively). When the difference values of stimulated and unstimulated SFRM were compared post treatment, they were significant in favor of the intervention group (p<0.001, p<0.001, respectively). The results of ANOVA, unstimulated SFRM for the group factor (F=67.22; p=0.00; η^2=0.66) and group × time interaction (F=59.90; p<0.001; η^2=0.63), and Stimulated SFRM for the group factor (F=164.07; p<0.001; η^2=0.82) and group × time interaction (F=108.04; p<0.001; η^2=0.76) revealed statistically high levels of effect (Table 2).

Secondary Outcome Measures

Statistically significant improvement was observed in HAQ, OHIP-14, OHRQOL-UK, BDI, BAI, SF-36 (physical component and mental component), and PSQI in both the groups when pre- and post-treatment outcomes were compared (p<0.001, p=0.001; p<0.001, p<0.001; p<0.001, p<0.001; p<0.001, p<0.001; p<0.001, p<0.001; p<0.001, p<0.001; p<0.001, p<0.001; p<0.001, p<0.001; p<0.001, p<0.001, respectively). When the difference values of HAQ, OHIP-14, OHRQOL-UK, BDI, BAI, SF-36 (physical component and mental component), and PSQI were compared post treatment, they were significant in favor of the intervention group (p=0.013, p<0.001, p<0.001, p<0.001, p=0.043, p<0.001, p<0.001, p<0.001, respectively). The results of ANOVA, HAQ for the group factor (F= 44.01; p<0.001; η^2=0.56) and group × time interaction (F=17.49; p<0.001; η^2=0.34), OHIP-14 for the group factor (F=338.04; p<0.001; η^2=0.90) and group × time interaction (F=61.29; p<0.001; η^2=0.64), BDI for the group factor (F=125.39; p<0.001; η^2=0.78) and group × time interaction (F=56.61; p<0.001; η^2=0.62), BAI for the group factor (F=96.37; p<0.001; η^2=0.73) and group × time interaction (F=39.56; p<0.001; η^2=0.53), SF-36 Physical component for the group factor (F=296.36; p<0.001; η^2=0.90) and group × time interaction (F=29.40; p<0.001; η^2=0.47), SF-36 mental component for the group factor (F=330.84; p<0.001; η^2=0.90) and group × time interaction (F=44.20; p<0.001; η^2=0.57), and PSQI for the group factor (F=127.66; p<0.001; η^2=0.79) and group × time interaction (F=103.61; p<0.001; η^2=0.75) revealed statistically significant differences. There was also OHRQOL-UK for the group factor (F=4.81; p=0.03; η^2=0.12) and group × time interaction (F=4.22; p=0.04; η^2=0.11) revealed statistically modarete differences (Table 2).

DISCUSSION

In this study, 8 weeks of IFC therapy was applied to individuals with pSS as active and sham-based methods together with clinical Pilates exercises. Our results, salivary flow rate in individuals with pSS increased significantly compared to sham and its effectiveness was maintained over time. When the post-treatment data were compared, the groups did not show superiority to each other in any other parameters. Therefore, effect size analysis was performed, which showed that intervention group had a greater effect on salivary flow rate, health status, OHRQOL, depression, anxiety, general quality of life and sleep quality. Consequently, increasing salivary flow rate with IFC therapy in individuals with pSS helped improve clinical symptoms. In addition, clinical Pilates exercises contributed to the improvement of disease effects and psychosocial parameters. IFC therapy helps individuals receive a treatment safely because it does not cause pain or discomfort. Moreover, we believe that IFC therapy motivates the participants by improving their salivary functions and hence supports them psychosocially. In line with all these results, all our hypotheses were confirmed.

Low saliva secretion observed in individuals with pSS has a negative effect on oral health. As stated in the 2019 recommendation report of EULAR, studies have shown that electrical stimulation, a non-pharmacological treatment method used to treat dry mouth, is effective in stimulating saliva production (1). Strietzel et al. (29) stated that saliva production increased with oral mucosa stimulation using a custom intraoral removable device. However, the clinical application of these technologies for dry mouth has been limited due to the

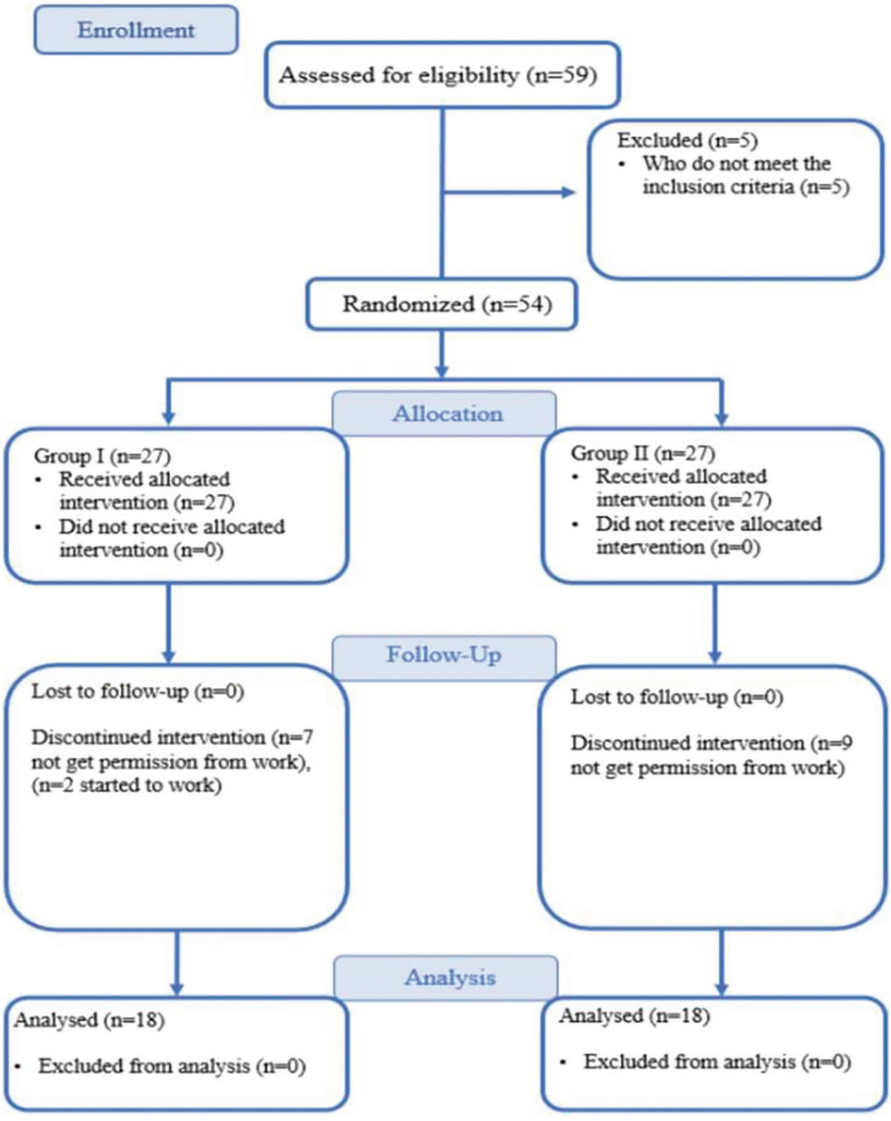

Figure 3. The flow chart of the study.

Table 2.Changes over time within and between groups

Variables	Pre-treatment (M ± SD)	Post-treatment (At 8th weeks) (M ± SD)	At 20th weeks (M ± SD)	At 32nd weeks (M ± SD)	At 44th weeks (M ± SD)	F (p) group effect	F (p) Interaction effect
Unstimulated SFRM (mL/min)							
Intervention group	1.48±1.05	4.94±1.58	5.10±1.71	4.53±1.79	3.91±1.73	67.22 (**<0.001***)	59.90 (**<0.001***)
Control group	1.99±1.86	1.94±1.74	2.26±1.55	1.91±1.50	1.52±1.40		
Partial eta- squared (η^2)						0.664	0.638
Stimulated SFRM (mL/min)							
Intervention group	1.75±0.93	5.74±1.45	6.30±1.38	6.04±1.42	5.23±1.33	164.07 (**<0.001***)	108.04 (**<0.001***)
Control group	2.49±2.21	2.48±1.83	3.25±1.81	3.01±1.79	2.44±2.07		
Partial eta- squared (η^2)						0.828	0.761
HAQ							
Intervention group	0.81±0.55	0.34±0.39	0.36±0.38	0.36±0.38	0.40±0.41	44.01 (**<0.001***)	17.49 (**<0.001***)
Control group	0.65±0.43	0.40±0.27	0.42±0.27	0.52±0.20	0.77±0.22		
Partial eta- squared (η^2)						0.564	0.340
OHIP-14							
Intervention group	30.94±6.03	7.83±2.12	5.66±2.35	7.94±2.12	8.94±2.31	338.04 (**<0.001***)	61.29 (**<0.001***)
Control group	26.27±5.65	16.66±5.16	14.44±4.44	17.44±4.50	19.50±4.87		
Partial eta- squared (η^2)						0.909	0.643
OHRQOL-UK							
Intervention group	36.11±3.67	47.05±1.16	45.61±2.14	44.33±2.16	48.77±2.33	4.81 (**0.03***)	4.22 (**0.04***)
Control group	38.83±3.01	42.61±2.42	41.11±2.94	39.55±2.93	36.77±2.21		
Partial eta- squared (η^2)						0.124	0.110
BDI							
Intervention group	20.44±8.24	4.38±3.48	3.83295	4.772.66	5.772.69	125.39 (**<0.001***)	56.61 (**<0.001***)
Control group	15.88±6.21	7.66±2.63	6.382.11	14.222.15	20.112.02		
Partial eta- squared (η^2)						0.787	0.625
BAI							
Intervention group	21.94±10.80	7.05±5.05	6.44±4.76	6.11±2.92	7.22±3.17	96.37 (**<0.001***)	39.56 (**<0.001***)
Control group	19.44±6.07	8.16±2.12	7.16±2.17	16.00±4.07	22.22±3.28		
Partial eta- squared (η^2)						0.739	0.538

Table 2. Continued

Variables	Pre-treatment (M ± SD)	Post-treatment (At 8th weeks) (M ± SD)	At 20th weeks (M ± SD)	At 32nd weeks (M ± SD)	At 44th weeks (M ± SD)	F (p) group effect	F (p) Interaction effect
SF-36							
Physical component							
Intervention group	154.72±62.65	312.50±51.54	342.36±41.84	322.95±44.70	302.98±43.56	296.36 (**<0.001***)	29.40 (**<0.001***)
Control group	176.25±49.61	274.30±35.58	277.49±38.68	260.79±40.97	239.61±42.60		
Partial eta- squared (η^2)						0.900	0.471
Mental component							
Intervention group	136.40±46.92	341.67±37.00	310.80±35.98	292.30±38.43	274.50±41.99	330.84 (**<0.001***)	44.20 (**<0.001***)
Control group	175.69±38.52	279.49±26.75	255.32±29.47	235.08±33.32	216.39±32.49		
Partial eta- squared (η^2)						0.909	0.573
PSQI							
Intervention group	9.83±4.80	3.05±3.26	3.33±3.25	3.66±3.36	4.22±3.49	127.66 (**<0.001***)	103.61 (**<0.001***)
Control group	9.77±3.37	6.22±2.60	8.33±2.93	11.22±3.37	14.72±3.26		
Partial eta- squared (η^2)						0.790	0.753

*F: Spanova Statistics, M: Mean, SD: Standard Deviation, SFRM: Salivary Flow Rate Measurement, HAQ: Health Assessment Questionnaire, OHIP-14: Oral Health Impact Profile-14, OHRQOL-UK: Oral Health-Related Quality of Life-United Kingdom Questionnaire, BDI: Beck Depression Inventory, BAI: Beck Anxiety Inventory, SF-36: Short Form-36, PSQI: Pittsburgh Sleep Quality Index, mL: Milliliter, min: Minute.

discomfort from electrical stimulation and the unavailability of portable devices. In the literature, the focus has mostly been on electrotherapy in the treatment of dry mouth. In the meta-analysis study conducted by Sivaramakrishnan and Sridharan (8). it was reported that the current type, frequency and amplitude of electrotherapy do not support its use in individuals with pSS.

A study was conducted on IFC therapy and its effect on dry mouth was examined. In a pilot study conducted by Hasegawa et al. (5), it was found that IFC therapy applied as a single session slightly increased the saliva flow in people with dry mouth and stimulated saliva secretion.

IFC therapy stands out as an effective electrical stimulation method since it is painless and does not cause discomfort (30). In parallel with this study, our study shows that IFC therapy applied under the supervision of a physiotherapist is associated with clinically significant improvement and active IFC therapy + clinical Pilates exercises led to high clinical improvement at all time points follow-up period. We think that the amount of saliva increases with its effect on the submandibular and sublinguinal glands, which constitute approximately 70% of saliva production. The fact that the participants were under observation during the application provided a more controlled progression of the treatment and reduced the possibility of any side effects.

The effects of dry mouth on life expectancy in individuals with pSS have been shown in various studies in the literature. In a descriptive study, Fernández-Martínez et al. (31) reported that symptomatic treatment of dry mouth would help to improve the oral quality of life of these individuals by preventing infections, caries, and tooth loss. Rusthen et al. (32) reported that low saliva secretion observed in individuals with pSS may have a significant negative effect on oral health and may contribute to speech, eating, and swallowing difficulties as well as mucosal infection and tooth decay. In the literature, the oral health-related OHRQoL questionnaire is widely used in these individuals and that the quality of life of these individuals decreases (33). In our study, we thought that the psychosocial effect caused by the burden of rheumatic disease contributes to the deterioration of oral quality of life in addition to the deterioration of physical oral health due to dry mouth. As a result of our study, significant improvements were obtained in the quality of life related to oral health. Active IFC therapy + clinical Pilates exercises led to modate clinical improvement at all time points follow-up period. Physical effects due to oral diseases and psychosocial disorders resulting from disease-related parameters should be taken into consideration. In

addition to the physical oral health deterioration due to xerostomia, we thought that psychosocial effects caused by the burden of rheumatic diseases may be responsible for the deterioration of oral quality of life in individuals with pSS. Therefore, we believe that xerostomia should be treated in these individuals.

pSS is basically affects individuals emotionally. The depression rate seen in pSS is from 32 to 45.8% higher than healthy controls (34). Inal et al. (35) emphasized that the presence of depression in pSS is associated with persistent fatigue, decreased OHRQoL, loss of work productivity, increased physical disability, and medical costs. Anxiety, another psychosocial condition in pSS. Kotsis et al. (36) stated anxiety is more common than depression in pSS, but the prognosis is worse in the presence of depression in patients with pSS. Our study is the first to examine the effects of dry mouth treatment on depression and anxiety in individuals with pSS. In the present study, significant improvements were obtained in depression and anxiety in both groups. Active IFC therapy + clinical Pilates exercises led to hight clinical improvement at all time points follow-up period. We believe that adding clinical Pilates exercises to the treatment positively affects the impact of the treatment by improving the mood level.

In the study of Strömbeck et al. (37) by dividing 21 women with pSS into two groups, the exercise group was given 45 minutes of moderate to high-intensity aerobic exercise (Nordic walking) 3 days a week for 12 weeks. The control group was applied low-intensity home exercise program including flexibility exercises. As a result, aerobic exercise has positive effects on aerobic capacity, fatigue and depression. Ng et al. (38) showed that low physical activity was associated with depression and daytime sleepiness when they compared 273 individuals with pSS with age, gender and BMI-matched healthy controls. These researchers recommended that clinicians should explore the clinical benefit of increased physical activity as part of a holistic approach, considering the risk of developing secondary chronic disease due to low physical activity levels in pSS (38). In line with this information, we also examined the effectiveness of clinical Pilates exercises on participants in our study. In addition, we believe that the clinical Pilates exercises applied contribute positively to the improvement of the participants' psychosocial factors. We advocate that the psychosocial parameters of the individuals with pSS improved in both groups, as a result of increasing the well-being with the clinical Pilates exercises. Therefore, we recommend that clinical Pilates exercises be added to treatment programs and the effectiveness of different exercises be investigated.

Oral quality of life scales are generally used in studies on quality of life in patients with pSS. However, we thought of evaluating the general quality of life of these patients because they not only have dry mouth complaints but also have extraglandular findings. In a cross-sectional study on 304 female patients with pSS, Liu et al. (39) found that these patients have low quality of life together with anxiety and depression; pain and fatigue may be the main factors contributing to the increase in anxiety and depression by decreasing their quality of life. In our study, significant improvements were achieved in both groups in all parameters related to oral health and general health. At all time points, higher clinical improvement was achieved in favor of the active IFC therapy + clinical Pilates exercises. This result has shown us that the increased amount of saliva with IFC therapy has a positive effect on both oral and general health. We also believe that the clinical Pilates exercise program we applied supports the recovery process.

Chung et al. (40) reported in a study conducted on 257 individuals with pSS that the sleep quality is commonly deteriorated in these patients and the patients with poor symptom status were associated with low sleep quality. Also, they stated that it is necessary to be aware of low sleep quality in pSS with poor symptom status. In the present study, it was observed that the improvement in sleep quality was significant in both groups after treatment. Sleep quality was significantly improved at all time points in active IFC therapy+ clinical Pilates exercises. This result showed us that the IFC therapy we used to improve dry mouth symptoms increased sleep quality. In addition, it showed that increasing physical activity with clinical Pilates exercises contributed more positively to the result as a supportive treatment.

Strength and Limitations

Our study is the first randomized controlled single blind study to examine the effectiveness of IFC treatment in the treatment of dry mouth in individuals with pSS. Treatment was applied only to patients with dry mouth caused by pSS (excluding other factors that may cause dry mouth) and the groups were homogeneous in terms of sociodemographic characteristics with the stratified randomization technique. In addition, the mechanism of action of IFC therapy was explained to all participants schematically before starting the treatment. It is also the first study to examine the effect of dry mouth treatment on depression and anxiety in pSS. Another important point is that long-term follow-up was performed to determine the permanent effect of IFC therapy + clinical Pilates exercises in individuals with pSS. All these parameters are the strengths of our study. Our study has certain limitations. This study was that there is no third group to which only IFC therapy is applied. This may have influenced our view of the pure efficacy of IFC therapy. Although this type of current, discovered in the 1950s, is considered a limitation in terms of being an old application, the current has been used in the treatment of dry

mouth, which is one of the main problems of pSS, a common and current disease.

The sample loss was 33% in our study. The reason for the participants not continuing the therapy program was related to their private life; therefore, we did not examine it in detail. In future studies, we recommend that the effect of pSS on the individuals' life should be examined in more detail in terms of adaptation to therapy.

CONCLUSION

IFC therapy can be used as an effective treatment method in the management of symptoms and increased the effectiveness of exercise in pSS. Increasing the salivary flow rate in individuals with pSS helped to management clinical symptoms, contributing to the improvement of psychosocial parameters such as health status, oral and general health-related quality of life, depression, anxiety, and sleep quality. The effectiveness of IFC therapy was preserved against time. The clinical pilates exercises applied positively contribute to the improvement of the psychosocial factors of the individuals with pSS. Therefore, we suggest adding IFC therapy to exercise in pSS.

We believe that non-pharmacological, inexpensive, easily accessible, up-to-date and technological approaches that can treat dry mouth should be developed for future studies.

Ethics: This study was approved by the Pamukkale University Ethics Committee for Non-Interventional Clinical Research (approval number: 60116787-020/90548, date: 12.31.2018.

Informed Consent: All participants were informed in advance about the procedures and assessments to be performed in the study.

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Conflict of Interest: The authors declare that they have no conflicts of interest.

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REFERENCES

1. Brito-Zerón P, Retamozo S, Kostov B, Baldini C, Bootsma H, De Vita S, et al. Efficacy and safety of topical and systemic medications: a systematic literature review informing the EULAR recommendations for the management of Sjögren's syndrome. RMD Open. 2019;5(2):e001064.
2. Qin B, Wang J, Yang Z, Yang M, Ma N, Huang F, et al. Epidemiology of primary Sjögren's syndrome: a systematic review and meta-analysis. Ann Rheum Dis. 2015;74(11):1983-9.
3. Ramos-Casals M, Brito-Zerón P, Seror R, Bootsma H, Bowman SJ, Dörner T, et al. Characterization of systemic disease in primary Sjögren's syndrome: EULAR-SS Task Force recommendations for articular, cutaneous, pulmonary and renal involvements. Rheumatology. 2015;54(12):2230-8.
4. Emmelin N. Nerve interactions in salivary glands. J Dent Res. 1987;66(2):509-17.
5. Hasegawa Y, Sugahara K, Sano S, Sakuramoto A, Kishimoto H, Oku Y. Enhanced salivary secretion by interferential current stimulation in patients with dry mouth: a pilot study. Oral Surg Oral Med Oral Pathol Oral Radiol. 2016;121(5):481-9.
6. Ward AR. Electricity, fields and waves in therapy. New South Wales, Australia: Science Press; 1986. p. 232-4.
7. Gil-Montoya JA, Silvestre FJ, Barrios R, Silvestre-Rangil J. Treatment of xerostomia and hyposalivation in the elderly: a systematic review. Med Oral Patol Oral Cir Bucal. 2016;21(3):e355-66.
8. Sivaramakrishnan G, Sridharan K. Electrical nerve stimulation for xerostomia: A meta-analysis of randomised controlled trials. J Tradit Complement Med. 2017;7(4):409-13.
9. Zhang W, Chen Z, Li XM, Gao J, Zhao Y. [Recommendations for the diagnosis and treatment of Sjögren's syndrome in China]. Zhonghua Nei Ke Za Zhi. 2023;62(9):1059-67.
10. Santos EJF, Farisogullari B, Dures E, Geenen R, Machado PM; EULAR taskforce on recommendations for the management of fatigue in people with inflammatory rheumatic diseases. Efficacy of non-pharmacological interventions: a systematic review informing the 2023 EULAR recommendations for the management of fatigue in people with inflammatory rheumatic and musculoskeletal diseases. RMD Open. 2023;9(3):e0003350. Erratum in: RMD Open. 2023;9(4):e003350corr1.
11. Hackett KL, Deary V, Deane KH, Newton JL, Ng WF, Rapley T. Experience of sleep disruption in primary Sjögren's syndrome: a focus group study. Br J Occup Ther. 2018;81(4):218-26.
12. Strömbeck B, Ekdahl C, Manthorpe R, Jacobsson LT. Physical capacity in women with primary Sjögren's syndrome: a controlled study. Arthritis Rheum. 2003;49:681-8.
13. Natour J, Cazotti Lde A, Ribeiro LH, Baptista AS, Jones A. Pilates improves pain, function and quality of life in patients with chronic low back pain: a randomized controlled trial. Clin Rehabil. 2015;29(1):59-68.
14. Mason DK, Harden RM, Boyle JA, Jasani MK, Williamson J, Buchanan WW. Salivary flow rates and iodide trapping capacity in patients with Sjögren's syndrome. Ann Rheum Dis. 1967;26(4):311-5.
15. Häkkinen A, Kautiainen H, Hannonen P, Ylinen J, Arkela-Kautiainen M, Sokka T. Pain and joint mobility explain individual subdimensions of the health assessment questionnaire (HAQ) disability index in patients with rheumatoid arthritis. Ann Rheum Dis. 2005;64(1):59-63.
16. Küçükdeveci AA, Sahin H, Ataman S, Griffiths B, Tennant A. Issues in cross-cultural validity: example from the adaptation, reliability, and validity testing of a Turkish version of the Stanford Health Assessment Questionnaire. Arthritis Rheum. 2004;51(1):14-19.
17. Slade GD, Spencer AJ. Development and evaluation of the Oral Health Impact Profile. Community Dent Health. 1994;11(1):3-11.
18. Başoğlu ME, Karaağaçlıoğlu L, Yılmaz B. Developing a Turkish Oral Health Impact Profile-OHIP-14-TR. Turkiye Klinikleri J Dental Sci. 2014;20(2):85-92.

19. McGrath C, Bedi R. Population based norming of the UK oral health related quality of life measure (OHQoL-UK). Br Dent J. 2002;193(9):521-4.

20. Mumcu G, Inanc N, Ergun T, Ikiz K, Gunes M, Islek U, et al. Oral health related quality of life is affected by disease activity in Behçet's disease. Oral Dis. 2006;12(2):145-51.

21. Beck AT, Ward CH, Mendelson M, Mock J, ErbaugH J. An inventory for measuring depression. Arch Gen Psychiatry. 1961;4:561-71.

22. Hisli N. A study on the validity of the Beck Depression Inventory. Turk Psychol J. 1998;6:118-23.

23. Beck AT, Epstein N, Brown G, Steer RA. An inventory for measuring clinical anxiety: psychometric properties. J Consult Clin Psychol. 1988;56(6):893-7.

24. Ulusoy M, Sahin NH, Erkmen H. Turkish version of the Beck anxiety inventory: psychometric properties. J Cogn Psychother. 1998;12(2):163-72.

25. Koçyiğit H, Aydemir Ö, Fişek G, Ölmez N, Memiş A. Reliability and validity of the Turkish version of short form-36 (SF-36): a study in a group of patients will rheumatic diseases. Turk J Drugs Ther. 1999;12(2):102-6.

26. Buysse DJ, Reynolds CF 3rd, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res. 1989;28(2):193-213.

27. Ağargün MY, Kara H, Anlar Ö. The validity and reliability of the Pittsburgh Sleep Quality Index. Türk Psikiyatri Dergisi. 1996;7(2):107-15.

28. Cohen J. Statistical power analysis for the behavioral sciences. Routledge. 2013.

29. Strietzel FP, Lafaurie GI, Mendoza GR, Alajbeg I, Pejda S, Vuleti L, et al. Efficacy and safety of an intraoral electrostimulation device for xerostomia relief: a multicenter, randomized trial. Arthritis Rheum. 2011;63(1):180-90.

30. Chimenos-Kustner E, Marques-Soares MS. Burning mouth and saliva. Med Oral. 2002;7(4):244-53.

31. Fernández-Martínez G, Zamora-Legoff V, Hernández Molina G. Oral health-related quality of life in primary Sjögren's syndrome. Reumatol Clin (Engl Ed). 2020;16(2).92-6.

32. Rusthen S, Young A, Herlofson BB, Aqrawi LA, Rykke M, Hove LH, et al. Oral disorders, saliva secretion, and oral health-related quality of life in patients with primary Sjögren's syndrome. Eur J Oral Sci. 2017;125(4):265-71.

33. Enger TB, Palm Ø, Garen T, Sandvik L, Jensen JL. Oral distress in primary Sjögren's syndrome: implications for health-related quality of life. Eur J Oral Sci. 2011;119(6):474-80.

34. Koçer B, Tezcan ME, Batur HZ, Haznedaroğlu Ş, Göker B, İrkeç C, et al. Cognition, depression, fatigue, and quality of life in primary Sjögren's syndrome: correlations. Brain Behav. 2016;6(12):e00586.

35. Inal V, Kitapcioglu G, Karabulut G, Keser G, Kabasakal Y. Evaluation of quality of life in relation to anxiety and depression in primary Sjögren's syndrome. Mod Rheumatol. 2010;20(6):588-97.

36. Kotsis K, Voulgari PV, Tsifetaki N, Drosos AA, Carvalho AF, Hyphantis T. Illness perceptions and psychological distress associated with physical health-related quality of life in primary Sjögren's syndrome compared to systemic lupus erythematosus and rheumatoid arthritis. Rheumatol Int. 2014;34:1671-81.

37. Strömbeck BE, Theander E, Jacobsson LT. Effects of exercise on aerobic capacity and fatigue in women with primary Sjogren's syndrome. Rheumatology (Oxford). 2007;46(5):868-71.

38. Ng WF, Miller A, Bowman SJ, Price EJ, Kitas GD, Pease C, et al. Physical activity but not sedentary activity is reduced in primary Sjögren's syndrome. Rheumatol Int. 2017;37(4):623-31.

39. Liu Z, Dong Z, Liang X, Liu J, Xuan L, Wang J, et al. Health-related quality of life and psychological status of women with primary Sjögren's syndrome: a cross-sectional study of 304 Chinese patients. Medicine (Baltimore). 2017;96(50):e9208.

40. Chung SW, Hur J, Ha YJ, Kang EH, Hyon JY, Lee HJ, et al. Impact of sleep quality on clinical features of primary Sjogren's syndrome. Korean J Intern Med. 2019;34(5):1154-64.

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OBEZ KADINLARDA MAT VE REFORMER PİLATESİN KAS İSKELET SİSTEMİ ŞİKAYETLERİ, VÜCUT KOMPOZİSYONU VE YAŞAM KALİTESİNE ETKİSİNİN KARŞILAŞTIRILMASI: RANDOMİZE KONTROLLÜ ÇALIŞMA

ÖZ

Amaç: Bu çalışmanın amacı, mat pilates ve reformer pilates eğitiminin obez kadınlarda kas iskelet sistemi şikayeti, vücut kompozisyonu ve yaşam kalitesine etkilerini incelemektir.

Yöntem: Randomize kontrollü çalışmaya, yaşları 20-45 arasında değişen, vücut kütle indeksi (VKİ) 30 kg/m^2 ve üzeri 36 obez kadın dahil edildi. Katılımcılar mat pilates grubu (n=18) ve reformer pilates grubu (n=18) olmak üzere ikiye ayrıldı. Mat pilates ve reformer pilates grubundaki olgulara 8 hafta boyunca, haftada 3 gün, günde 60 dakika pilates eğitimi verildi. Eğitim öncesi ve sonrası olguların ekstremite ve gövde çevre ölçümleri Gullick şeridiyle, VKİ voit akıllı bluetooth dijital baskül ile, kas iskelet sistemi şikayetleri Nordic Kas İskelet Sistemi Anketi ile yaşam kaliteleri ise Obezlere Özgü Yaşam Kalitesi Anketi ile değerlendirildi.

Bulgular: Her iki grubun yaş, boy, kilo ve pilates eğitimi öncesi VKİ arasında anlamlı fark bulunmadı (p>0,05). Mat pilates grubu ve reformer pilates grubu ön test -son test kilo, VKİ, bel çevresi, kalça çevresi, bel/kalça oranı, yağ oranı, kas oranı ve visseral yağ oranı değerleri arasında anlamlı derecede azalma elde edildi (p<0,01). Gruplar arası karşılaştırmada sadece bel çevresi (p<0,002), bel/kalça oranı (p<0,001) ön test-son test değerleri ile son test kas oranı değerleri arasında anlamlı azalma görüldü (p<0,031). Mat pilates grubu kas iskelet sistemi şikayetleri (boyun, omuz, üst sırt, el, kol, kalça, diz, ayak ve dirsek) ön test-son test değerleri arasında anlamlı fark bulunmadı (p>0,05). Reformer pilates grubunun ön test-son test kas iskelet sistemi şikayetleri (boyun, omuz, üst sırt, dirsek, el, kalça ve diz bölgesi) değerleri arasında anlamlı fark bulundu (p<0,05). Mat pilates (p<0,01) ve reformer pilates grubu yaşam kalitesi ön test-son test değerleri arasında anlamlı derecede iyileşme görülürken (p<0,01) gruplar arası ön test-son test yaşam kalitesi değerleri arasında anlamlı fark bulunmadı (p>0,05).

Sonuç: Çalışmamızın sonuçları, her iki pilates egzersizlerinin vücut kompozisyonu ve yaşam kalitesini artırdığı, reformer pilatesin ise kas iskelet sistemi şikayetlerini azaltarak mat pilatese göre pozitif yönde daha etkili olduğunu gösterdi.

Anahtar Kelimeler: Vücut kompozisyonu, Kas iskelet sistemi şikayetleri, Obezite, Pilates, Yaşam kalitesi

COMPARISON OF THE EFFECTS OF MAT AND REFORMER PILATES ON MUSCLE SKELETAL SYSTEM COMPLAINTS, BODY COMPOSITION AND QUALITY OF LIFE IN OBESE WOMEN: RANDOMIZED CONTROLLED STUDY

ABSTRACT

Purpose: The purpose of this study is to examine the effects of mat pilates and reformer pilates training on musculoskeletal complaints, body composition and quality of life in obese women.

Methods: A randomized controlled study included 36 obese women aged between 20-45 years with a body mass index (BMI) of 30 kg/m^2 and above. Participants were divided into two groups as mat pilates group (n=18) and reformer pilates group (n=18). Pilates training was given to the cases in mat pilates and reformer pilates groups for 60 minutes per day, 3 days per week for 8 weeks. Before and after the training, the extremity and trunk circumference measurements of the cases were evaluated with Gullick strip, BMI with voit smart bluetooth digital scale, musculoskeletal complaints were evaluated with Nordic Musculoskeletal System Questionnaire and quality of life was evaluated with Obese Specific Quality of Life Questionnaire.

Results: No significant difference was found between the age, height, weight and pre-pilates training BMIs of both groups (p>0.05). A significant decrease was obtained between the pre-test and post-test weight, BMI, waist circumference, hip circumference, waist/hip ratio, fat ratio, muscle ratio and visceral fat ratio values of the mat pilates group and the reformer pilates group (p<0.01). In the comparison between the groups, a significant decrease was observed only between the pre-test and post-test values of waist circumference (p<0.002), waist/hip ratio (p<0.001) and post-test muscle ratio values (p<0.031). No significant difference was found between the pre-test and post-test values of the mat pilates group's musculoskeletal complaints (neck, shoulder, upper back, hand, arm, hip, knee, foot and elbow) (p>0.05). A significant difference was found between the pre-test and post-test values of the reformer pilates group's musculoskeletal complaints (neck, shoulder, upper back, elbow, hand, hip and knee area) (p<0.05). While there was a significant improvement between pre-test and post-test quality of life values of the mat pilates (p<0.01) and reformer pilates groups (p<0.01), there was no significant difference between pre-test and post-test quality of life values between the groups (p>0.05).

Conclusion: The results of our study showed that both pilates exercises increased body composition and quality of life, while reformer pilates was more effective than mat pilates by reducing musculoskeletal complaints.

Keywords: Body composition, Musculoskeletal complaints, Obesity, Pilates, Quality of life

GİRİŞ

Obezite, yağ dokusunun aşırı artışı sebebiyle meydana gelen yaygın bir halk sağlığı sorunudur. Başta gelişmiş ülkeler olmak üzere ülkemizde de görülme sıklığı gittikçe artan küresel bir problemdir (1). Dünya Sağlık Örgütü verilerine göre, Dünya'da yaklaşık 600 milyon insanın obez kategorisinde olduğu belirtilmektedir (2). Ekonomik Kalkınma ve İşbirliği Örgütü (Organisation for Economic Co-operation and Development-OECD) 2015 verilerine bakıldığında OECD ülkelerindeki yetişkin nüfusun %19,5'inin obez olduğu ayrıca Meksika, Macaristan ve Amerika Birleşik Devletleri gibi ülkelerde ise her üç kişiden en az birinin, İngiltere ve Finlandiya'da her dört kişiden birinin obez olduğu görülmektedir. Ülkemizde de obezitenin hızlı arttığı, Türkiye Diyabet Epidemiyolojisi Çalışması I (TURDEP I) ve TURDEP II çalışmalarına göre obezite oranı kadınlarda %32,9'dan %44,2'ye, erkeklerde %13,2'den %27,3'e, toplamda %22,3'ten %31,2'ye yükseldiği görülmektedir (3).

Obeziteye yaş, cinsiyet, eğitim, yanlış beslenme, aktivite yetersizliği, sosyo-kültürel ve ekonomik yapı, genetik, depresyon, sigara, alkol, ilaçlar, doğum sayısı gibi birçok faktörün neden olduğu bilinmektedir (4). Ayrıca teknolojinin hızla gelişmesi, insanların beslenme alışkanlıklarındaki farklılıklar ve yaşam biçimlerindeki değişimin, obezite görülme oranının artması morbidite ve mortalite oranı için önemli bir risk faktörüdür (5). Obezite, ölümcül hastalıklara neden olduğu gibi kas iskelet sistemi rahatsızlıklarına da neden olabilecek önemli bir risk faktörüdür. Bu sisteme ait birçok mekanik bozukluğun kişilerin yaşam kalitesini olumsuz yönde etkileyen depresyon gibi çeşitli mental rahatsızlıkları da beraberinde getirdiği görülmektedir (6).

Obezitenin tedavisinde; tıbbi beslenme tedavisi, egzersiz tedavisi, davranış değişikliği tedavisi, ilaç tedavisi, cerrahi tedavi yöntemleri uygulanmaktadır. Tedavide hayat tarzı değişikliğine ağırlık verilerek, hastanın kilo vermesini sağlamaktan ziyade obeziteye bağlı gelişen komplikasyonları düzeltmek özellikle amaçlanmaktadır. Obezite tedavisi süresince en önemli basamağın diyet ve egzersiz tedavisi olduğu bilinmektedir (7).

Pilates, Joseph Hubertus Pilates tarafından geliştirilmiş bireylerin zihinsel ve bedensel bütünlüğü dengeleyebilen ve genel sağlık durumunu iyileştirebilen egzersizler bütünüdür (7). Pilates egzersizlerin amacı; karın ve sırt bölgelerini eşit oranda güçlendirerek, vücudun üst bölgesinde sağlam bir iskelet yapısı oluşturmayı hedefleyen pilates egzersizleri, yerde mat üzerinde [mini ve swiss ball gibi araçlar yapılan egzersizleri içeren Klasik/klasik/geleneksel pilates, geliştirilmiş/uyarlanmış pilates (reformer pilates ekipmanları-hem yüksek hem de düşük yüklenmeli egzersizleri birleştirir, fitness tabanlıdır ve araç-gereç içerebilir) ve klinik pilates (fizyoterapistlerin tedavi için kullandığı tip)] olmak üzere üç temel formda sınıflandırılmıştır (8).

Günümüzde pilatesin rehabilitasyon programları açısından da popülaritesi artmakta olup ağrı, esneklik, fiziksel uygunluk, yaşam kalitesi, vücut kompozisyonu ve kor stabilitesi gibi pek çok parametre üzerine pozitif etkisinin olduğu görülmektedir (9). Kas iskelet sistemi ağrıları olan olgularda pilatesin güçlendirme egzersizlerine kıyasla eklem hareket açısı, fiziksel uygunluk ve çekirdek kuvveti üzerine daha etkin olduğu ve obez bireylerde tedavi programına eklenmesinin iyilik halinin artırılmasına katkı sağladığı belirtilmektedir (10,11). Literatüre bakıldığında mat ve reformer pilatesin obez bireylerde kas iskelet sistemi şikayetleri, vücut kompozisyonu ve yaşam kalitesine olan etkisini birlikte inceleyen bir çalışmaya rastlanmamıştır. Rosa ve diğ. (12) kas iskelet sistemi şikayetlerinin obez bireylerde yaşam kalitesini negatif yönde etkileyen önemli bir sorun olduğunu ve sistemsel şikayetlerin önlenmesi ve rehabilitasyonu için multidisipliner çalışmaların önemini vurgulamışlardır. Ayrıca konuyla ilişkin yeni çalışmalara ihtiyaç duyulduğunu ifade etmişlerdir.

Bu çalışmada; obez kadınlarda mat pilates ve reformer pilatesin kas iskelet sistemi şikayetleri, vücut kompozisyonu ve yaşam kalitesi üzerine etkilerini karşılaştırarak literatüre katkı sağlamak amaçlanmıştır.

YÖNTEM

Çalışmaya, Mart 2023-Temmuz 2023 tarihleri arasında Özel Sağlıklı Yaşam ve Pilates Merkezi'ne gelen dahil edilme kriterlerine uygun obez, vücut kütle indeksi (VKİ) 30 ve üzeri, egzersiz yapmayı engelleyecek kardiyovasküler, pulmoner ve ortopedik herhangi bir hastalığı olmayan, uygulanacak egzersiz programına düzenli olarak katılabilen, son 6 ay içerisinde operasyon geçirmeyen, başka bir spor veya diyet programına dahil olmayan 20-45 yaş arası, obez 36 kadın gönüllü olarak dahil edildi. Katılımcılar, web sitesinde "Research Randomizer" isimli randomizasyon programı ile rastgele numaralarla randomize edildi. Numaraların, bilgisayar programı tarafından hangi gruba ait oldukları önceden belirlenmiş ve numaralar kapalı zarflara konulmuştur. Zarflar, katılımcıların geliş sırasına göre seçilerek her bir bireyin hangi egzersiz grubuna dahil olacağı belirlenmiştir. Randomizasyon sonucunda, 20 kişi Mat Pilates Egzersiz Grubu'na (MPG) dahil edilirken, 20 kişi Reformer Pilates Grubu'na (RPG) dahil edilmiştir. MPG: 30, 11, 38, 14, 16, 2, 5, 9, 33, 35, 19, 29, 34, 15, 23, 20, 40, 3, 39, 25 RPG: 4, 37, 1, 22, 31, 10, 7, 17, 8, 13, 26, 6, 21, 27, 36, 32, 24, 28, 12, 18 şeklinde randomize olarak grup dağılımı yapılmıştır. Çalışmaya, başka bir spor veya diyet programına dahil olan, efor kapasitesini kısıtlayan kardiovasküler sistem rahatsızlığı olan, egzersiz kontrendikasyonu olan, kontrol edilemeyen hipertansiyonu olan, vertigosu, ciddi respiratuvar bozukluğu ve geçirilmiş koroner arter hastalığı olanlar dahil edilmedi.

Çalışma protokolü Üsküdar Üniversitesi Girişimsel Olmayan Araştırmalar Etik Kurulu tarafından 22.03.2023 tarihli 2023/03 sayılı karar numarası ile onaylanmış ve Helsinki Bildirgesi prensiplerine uygun olarak yürütülmüştür.

Değerlendirme ve Yöntemi

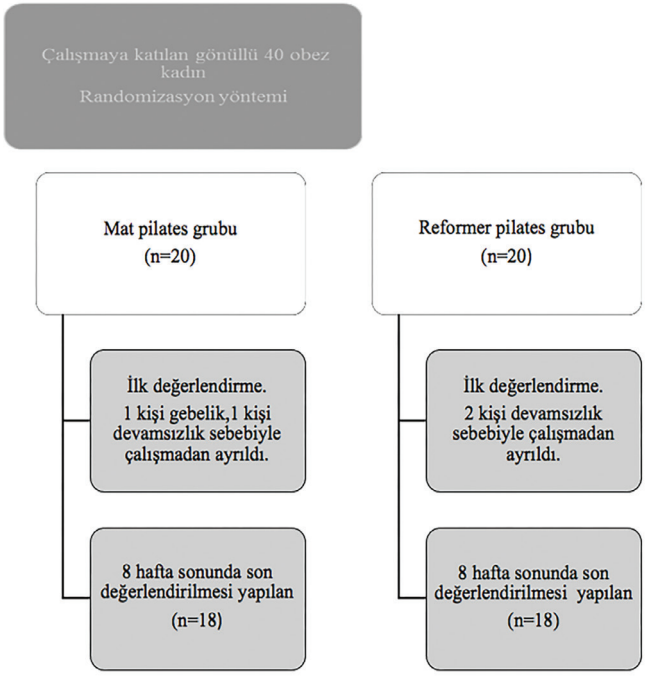
Katılımcılara sertifikalı eğitmen tarafından, 8 hafta boyunca haftada 3 gün ve 60 dakika (sırasıyla 5 dk. klasik/geleneksel pilates, egzersiz, 5 dk. soğuma) mat pilates ve reformer pilates eğitimi verildi. Eğitim programına başlamadan önce katılımcılara mat pilates ve reformer pilatesin temel hareket prensipleri (fundamentals) anlatılıp, uygulamaları gösterildi. Ayrıca katılımcılara çalışma süresince herhangi bir özel diyet uygulanmadı ve günlük beslenme alışkanlıklarını sürdürmeleri istendi (Şekil 1).

Egzersiz programları: Tablo 1 ve Tablo 2'de 8 haftalık mat pilates ve reformer pilates eğitimleri detaylı olarak verilmiştir (13).

Veri Toplama Araçları

Sosyodemografik ve Klinik Bilgiler Formu: Yaş (yıl), boy (cm), vücut ağırlığı (kg), VKİ (kg/m^2), bel ve kalça çevresi ile bel/kalça oranları kaydedildi.

Vücut Ağırlığı Ölçümü: Hassaslık derecesi ±0,1 kg olan Voit marka akıllı bluetooth dijital baskül yağ ölçüm ve vücut analizi tartısı ile katılımcıların üzerinde şort, tişört olacak şekilde, ayakkabısız olarak standart tekniklere göre alınmıştır.



Şekil 1. Çalışmanın akış şeması.

Boy: Seca marka boy ölçer ile ayakkabısız olarak ölçüldü (14).

Vücut Kütle İndeksi: VKİ, [vücut ağırlığı/(boy)^2] formülü ile hesaplanmıştır (15).

Çevre Ölçümü: Çevre ölçümü Gullick şeridi kullanılarak bel, abdomen, kalça bölgelerinden standart tekniklere göre yapıldı. Her bir bölgeden iki ölçüm yapılarak ortalaması alındı (16).

Nordic Kas İskelet Sistemi Anketi: İlk defa Kuorinka ve diğ. (17) tarafından kullanılan bu ankette katılımcıya son bir yıl, son bir ay ve bir hafta içinde dokuz vücut alanındaki (boyun, omuz, dirsek, el bileği/el, sırt, bel, kalça/uyluk, diz ve ayak bileği/ayak) ağrının ilk başlama yaşı, ağrı nedeniyle hastaneye yatma ve görev değiştirme varlığı, son bir hafta, bir ay ve bir yıl içinde ağrı sorunu yaşayıp yaşamadığı, ağrının günlük yaşamını etkileyip etkilemediği, bu nedenle hekime/fizyoterapiste gidip gitmediği, ağrı kesici kullanımı ve ağrı nedeniyle rapor

Tablo 1. Sekiz haftalık mat pilates egzersiz eğitimi

Isınma egzersizleri (1 set, 10 tekrar)	• Roll down (yuvarlanma)
	• Toy soldier (oyuncak asker)
	• Mini squat (minik çömelme)
	• Tempolu adımlama
	• Side stretch
	• Chest stretch
Mat pilates egzersizleri 1-4. hafta (1 set, 10 tekrar) 4-8. hafta (1 set, 20 tekrar therabant ile)	• Breathing (nefes)
	• Roll up (yuvarlama)
	• Shoulder bridge (omuz köprüsü)
	• Chest lift with rotation (rotasyonlu göğüs kaldırma)
	• Marching (yürüme)
	• Criss-cross (çapraz)
	• Toe taps from chair position (masa pozisyonu karın çalışması)
	• Single leg circle (tek bacak çember)
	• Side lying (yan yatma, yan tekme)
	• Back, hip twist (kalça bükme)
	• Swan (kuğu), Cobra (kobra)
	• Single leg, kickin (tek ayak tekme)
	• Quadruped (dört ayak egzersizleri)
	• Push up (yukarı itme)
	• Clam (istiridye egzersizleri)
	• Elbow plank (dirsek plank)
Soğuma egzersizleri (1 set, 10 tekar)	• Quadriceps esnetme
	• Hamstring esnetme
	• Kalça addüktör, fleksör esnetme
	• Triceps stretch/kol-omuz esnetme
	• Child's pose (çocuk pozu)

alıp almadığı ile ilgili güvenilir bilgi sağlayan, kendi kendine veya kişisel görüşme tekniği ile doldurulabilen bir ankettir. Genişletilmiş Nordic Kas İskelet Sistemi Anketi (GNKİSA) çalışan ve/veya genel toplumlarda yapılan çalışmalarda kas iskelet sistemi ağrıları ve ilgili durumlar için kullanılabilen bir ölçektir. Çalışmamızda GNKİSA çalışmaya katılan bireyler tarafından doldurulmuştur. Tüm soruların cevaplanması 10-15 dakika gibi kısa bir zaman almaktadır (18).

Obezlere Özgü Yaşam Kalitesi Ölçeği: 2013 yılında Çıray Gündüzoğlu ve diğ. (19) tarafından geçerlilik ve güvenirliliği yapılan ölçek, Likert tipi (0-7) 17 maddeden oluşmaktadır. Ölçeğin tüm maddeleri toplanarak tek yaşam kalitesi puanı elde edilir. Tüm puanlar toplanıp, bu puandan 17 çıkarılır ve elde edilen sayı 102'ye bölünür, 100 ile çarpılır. Ölçekten alınan toplam puan 0'a yaklaştıkça yaşam kalitesi azalmakta, 100'e yaklaştıkça yaşam kalitesi artmaktadır.

İstatistiksel Analiz

Elde edilen veriler, Windows tabanlı SPSS 17.0 paket programı (Statistical Package for Social Sciences) Windows v25.0 kullanılarak analiz edildi. Nicel veriler için ortalama ve standart sapma, nitel veriler için frekans analizi kullanıldı.

Değişkenleri normal dağılıma uygunluğu analitik yöntemler (tek örneklem Kolmogorov-Smirnov) ve görsel (histogram) kullanılarak incelendi. Egzersiz eğitimi öncesi ve sonrası grup içi karşılaştırılması Paired t-testi, gruplar arası karşılaştırılma Bağımsız t-testi kullanılmıştır. Binary verilerin egzersiz eğitimi öncesi ve sonrası ve grup içi karşılaştırılmasında McNemar testi grupların karşılaştırılmasında ise ki-kare testi kullanıldı. Anlamlılık düzeyi 0,05 olarak kabul edildi.

Örneklem büyüklüğünü belirlemek için G*Power (v3.1.7) programı kullanılarak güç analizi yapıldı. Çalışmanın gücü 1-β (β=II. tip hata olasılığı) olarak ifade edilmiş ve referans olarak önceki bir çalışmanın sonuçları baz alınarak örneklem sayısı için α=0,05 düzeyinde %80 güç ve etki büyüklüğü (d) 1.058 ile her gruba en az 20 birey alınması gerektiği hesaplanmıştır (20).

BULGULAR

Çalışmaya 20-45 yaş (yıl) aralığında, VKİ 30 kg/m^2 ve üzeri olan gönüllü 36 obez kadın dahil edilmişti. Bireylerin egzersiz öncesi-sonrası demografik ve klinik bilgileri grup içi ve gruplar arası karşılaştırılması Tablo 3 ve 4'te verilmiştir. Gruplar arası egzersiz eğitimi öncesi yaş, kilo, boy ve VKİ açısından istatistiksel olarak anlamlı fark bulunmadı. MPG ve RPG'nin eğitim öncesi ve sonrası kilo, VKİ, bel çevresi, kalça çevresi, bel/

Tablo 2. Sekiz haftalık reformer pilates egzersiz eğitimi

Isınma egzersizleri (1 set, 10 tekrar)	• Roll down (yuvarlanma)
	• Toy soldier (oyuncak asker)
	• Mini squat (minik çömelme)
	• Tempolu adımlama
	• Side stretch
	• Chest stretch
Reformer egzersizleri 1-4. hafta (1 set, 10 tekrar) 4-8. hafta (1 set, 20 tekrar)	• Ayak çalışması (footwork)
	• Sırtüstü kol çalışması (supine arm work)
	• Kayış ile ayak çalışması (feet in straps)
	• Kayış ile ayak germe
	• Kol çalışması (arm work)
	• Kısa kutu ile karın çalışması
	• Köprü çalışması (bridging)
	• Ladder Barrel ile germe çalışması
	• Yan gövde germe (seadet mermaid)
	• Side splints
	• Rowing
	• Leg springs (kalça fleksiyon-ekstansiyon)
Soğuma egzersizleri (1 set, 10 tekrar)	• Quadriceps esnetme
	• Hamstring esnetme
	• Kalça addüktör, fleksör esnetme
	• Triceps stretch/kol-omuz esnetme
	• Child's pose (çocuk pozu)

Tablo 3. Grupların yaş, boy, kilo ve VKİ karşılaştırılması

Değişkenler	Grup (N)	Ortalama	Standart sapma	p
Yaş (yıl)	Mat pilates (18)	32,72	5,61	>0,050
	Reformer pilates (18)	30,16	5,74	
Boy (cm)	Mat pilates (18)	158,50	7,08	>0,050
	Reformer pilates (18)	156,66	7,76	
Egzersiz öncesi kilo (kg)	Mat pilates (18)	98,72	15,04	>0,050
	Reformer pilates (18)	97,05	10,72	
Egzersiz öncesi VKİ (kg/m²)	Mat pilates (18)	39,45	6,70	>0,050
	Reformer pilates (18)	39,70	5,83	

VKİ: Vücut Kütle İndeksi, *p<0,05.

kalça oranı, yağ oranı, kas oranı ve visseral yağ oranı değerleri karşılaştırılmasında anlamlı azalma olduğu tespit edildi. Gruplar arası sadece bel çevresi, kalça çevresi, bel/kalça oranı ve kas oranı değerleri arasında istatistiksel olarak anlamlı fark bulundu.

Her iki grubun egzersiz eğitim öncesi sonrası kas iskelet sistemi şikayetlerinin karşılaştırılmasına Tablo 5'te ayrıntılı şekilde verilmiştir. Egzersiz öncesi ve sonrası her iki grubun kas iskelet sistemi şikayetlerinin (boyun, omuz, üst sırt, dirsek, el, bel, kalça, diz, ayak ağrısı) grup içi karşılaştırılmasında MPG'de istatistiksel olarak anlamlı fark bulunmamıştır. RPG'de ayak ve bel ağrısı hariç boyun ağrısı, omuz, üst sırt ağrısı, dirsek ağrısı el ağrısı, kalça ağrısı, diz ağrısı düzeylerinde istatistiksel olarak anlamlı fark bulunmuştur. Egzersiz öncesi ve sonrası gruplar arası karşılaştırmada ise istatistiksel olarak anlamlı fark bulunmamıştır.

Grupların egzersiz eğitim öncesi sonrası yaşam kaliteleri Tablo 6'da ayrıntılı şekilde verilmiştir. Her iki grubun egzersiz eğitimi öncesi ve sonrası yaşam kalitesi değerlerinin grup içi karşılaştırılmasında istatiksel olarak pozitif yönde fark bulunurken gruplar arası karşılaştırmada istatistiksel olarak fark bulunmamıştır.

TARTIŞMA

Çalışmamızda, mat pilates ve reformer pilates eğitimlerinin obez kadınların kas iskelet sistemi şikayetleri, vücut kompozisyonları ve yaşam kaliteleri üzerine etkisini inceledik. Çalışmamızın sonuçlarına bakıldığında her iki grubun yaş, boy, kilo ve pilates eğitimi öncesi VKİ'ler arasında anlamlı fark bulunmadı. MPG ve RPG ön test-son test kilo, VKİ, bel çevresi, kalça çevresi, bel/kalça oranı, yağ oranı, kas oranı ve visseral yağ oranı değerleri arasında anlamlı derecede azalma elde edildi. Gruplar arası karşılaştırmada ön test-son test bel çevresi, bel/kalça oranı değerleri arasında ve son test kas oranı değerleri arasında anlamlı azalma görüldü. MPG kas iskelet sistemi şikayetleri (boyun, omuz, üst sırt, el, kol, kalça, diz, ayak ve dirsek) ön test-son test değerleri arasında anlamlı fark bulunmadı. RPG'nin (bel ve ayak hariç) ön test-son test kas iskelet sistemi şikayetleri (boyun, omuz, üst sırt, dirsek, el, kalça ve diz bölgesi) değerleri arasında pozitif yönde anlamlı fark bulundu. MPG ve RPG yaşam kalitesi ön test-son test değerleri arasında anlamlı derecede iyileşme görülürken gruplar arası ön test-son test yaşam kalitesi değerleri arasında anlamlı fark bulunmadı.

2000'li yılların başlarından itibaren pilatesin vücut kompozisyonuna olan etkisini araştıran çalışmalardan elde edilen sonuçlar çelişkili olmasına rağmen aşırı kilolu veya obez yetişkinlerde vücut ağırlığını ve vücut yağ yüzdesini önemli ölçüde azalttığı belirtilmektedir (21). Cakmakçi (22) sedanter kadınlarda, 10 haftalık mat pilates egzersiz programının vücut ağırlığı, VKİ, bel çevresi, bel-kalça oranı değerlerini anlamlı derecede azalttığını belirtmektedir. Uzun ve Demir (11) sedanter kadınlarda 8 haftalık mat pilates ve reformer

Tablo 4. Vücut kompozisyonunun egzersiz eğitimi öncesi ve sonrası grup içi -gruplar arası karşılaştırması

	Mat pilates	Grup içi	Reformer pilates	Grup içi	Gruplar arası
	Ort. ± SS	p	Ort. ± SS	p	p
Eğt. ö. kilo (kg)	98,72±15,04	**<0,010**	97,05±10,72	**<0,010**	0,527
Eğt. s. kilo (kg)	96,52±14,20		92,97±9,48		0,303
Eğt. ö. VKİ (kg/m²)	39,45±6,70	**<0,010**	39,70±5,83	**0,020**	0,899
Eğt. s. VKİ (kg/m²)	38,53±6,36		38,13±5,20		0,716
Eğt. ö. bel çevresi (cm)	98,83±8,36	**<0,010**	92,50±7,10	**<0,010**	**0,011***
Eğt. s. bel çevresi (cm)	95,77±8,07		87,11±7,01		**0,002***
Eğt. ö. kalça çevresi (cm)	114,05±9,68	**<0,010**	115,94±8,42	**<0,010**	0,505
Eğt. s. kalça çevresi (cm)	109,94±9,63		108,38±7,67		0,775
Eğt ö. bel/kalça (cm)	98,83±8,36	**<0,010**	92,50±7,11	**<0,030**	**0,001****
Eğt. s. bel kalça/kalça (cm)	95,78±8,08		87,11±7,0		**0,001****
Eğt. ö. yağ oranı (%)	45,50±4,09	**<0,010**	46,44±4,71	**<0,010**	0,494
Eğt. s. yağ oranı (%)	43,90±4,09		44,34±4,58		0,624
Eğt. ö. kas oranı (%)	45,49±4,00	**<0,010**	47,16±2,06	**0,020**	0,104
Eğt. s. kas oranı (%)	43,25±3,74		46,08±2,28		**0,031***
Eğt. ö. visseral yağ oranı (%)	14,83±4,52	**0,030**	17,61±3,51	**<0,010**	0,065
Eğt. s. visseral yağ (%)	14,11±4,34		16,66±3,12		0,059

VKİ: Vücut Kütle İndeksi, Ort.: Ortalama, SS: Standart Sapma, Eğt. ö.: Egzersiz Eğitimi Öncesi, Eğt. s.: Eğitim Sonrası, *: p<0,05 **: p<0,001.

pilatesin antropometrik özellikler üzerine etkisini incelendiği randomize kontrollü çalışmalarında hem mat pilates hem de reformer pilatesin bel/kalça oranı, kol, göğüs, bel, karın, kalça ve uyluk çevre ölçümlerinde egzersiz öncesine göre anlamlı düzeyde azalttığı görülmektedir. Liman ve Atalay Güzel'in (23),, 30 sedanter kadın bireyleri 8 haftalık pilates (grup 1) ve aerobik-step (grup 2) egzersiz programına dahil etikleri çalışmalarında, olguların fiziksel ve fizyolojik parametreleri, bel ve kalça çevre kalınlıkları üzerine hem pilates hem de aerobik-step egzersizlerinin bel/kalça oranı değerleri üzerine ise pilates egzersizlerinin anlamlı düzeyde daha etkili olduğu belirtilmektedir. Vaquero-Cristóba ve diğ. (24) aktif yetişkin kadınlarda 16 haftalık reformer pilates eğitiminin vücut kütlesi ve VKİ üzerinde etkili olmadığını ancak kas kütlesinde artış ve yağ kütlesinde azalmaya neden olduğunu belirtmişlerdir. Pilates yapan 30-45 yaşları arasında 28 kadın üzerinde yapılan bir başka çalışmada da pilatesin ağırlık, VKİ, vücut yağ oranı, bel çevresi ve kalça çevresi ölçüm değerlerini anlamlı düzeyde azalttığı, esnekliği ise arttırdığı tespit edilmiştir. Altıntaç (25) yaptığı çalışmada, aletli (reformer) ve aletsiz (mat work) yapılan pilates egzersizlerinin kişilerin ortalama vücut ağırlıklarının, VKİ'lerinin, vücut yağ yüzdelerinin, vücut yağ kütlesinin, yağsız kütle değerlerinin, bel ve kalça çevresinin ve bel/kalça oranlarını azalttığı tespit edilmiştir. Wang ve diğ.'nin (26) çalışmasında, 8 haftalık mat pilates ve reformer pilates egzersizlerinin sedanter kadınların karın kas dayanıklılığını anlamlı düzeyde artırdığı görülmektedir. Literatürde, pilates egzersizlerinin etkinliğinin en az 6-8 haftalık seansların (her bir seans en az 30 dakika olacak şekilde) planlanması ile uygun olacağı belirtilmektedir (27). Bizde çalışmamızda 8 hafta, haftada 3 gün ve her bir seans 60 dakika olacak şekilde planlanan mat pilates ve reformer pilatesin olguların vücut kompozisyonu parametreleri

Tablo 5. Kas iskelet sistemi şikayetlerinin egzersiz eğitimi öncesi-sonrası grup içi ve gruplar arası karşılaştırması

		Mat pilates (n=18)		Grup içi	Reformer pilates (n=18)		Grup içi	Gruplar arası
		Egzersiz öncesi n (%)	Egzersiz sonrası n (%)		Egzersiz öncesi n (%)	Egzersiz sonrası n (%)	p	p
Boyun	Evet	7 (38,9)	6 (33,3)	0,990	9 (50,0)	4 (22,2)	**0,010***	0,460
	Hayır	11 (61,1)	12 (66,7)		9 (50,0)	14 (77,8)		
Omuz	Evet	2 (11,1)	2 (11,1)	0,990	8 (44,4)	4 (22,2)	**0,020***	0,550
	Hayır	16 (88,9)	16 (88,9)		10 (55,6)	14 (77,8)		
Üst sırt	Evet	4 (22,2)	2 (11,1)	0,500	6 (33,3)	1 (5,6)	**0,020***	0,730
	Hayır	14 (77,8)	16 (88,9)		12 (66,7)	17 (94,4)		
Dirsek	Evet	5 (27,8)	4 (22,2)	0,250	11 (61,1)	6 (33,3)	**0,030***	0,210
	Hayır	13 (72,2)	14 (77,8)		7 (38,9)	12 (66,7)		
El	Evet	6 (33,3)	2 (11,1)	0,130	8 (44,4)	1 (5,6)	**0,030***	0,550
	Hayır	12 (66,7)	16 (88,9)		10 (55,6)	17 (94,4)		
Bel	Evet	9 (50,0)	6 (33,3)	0,250	9 (50,0)	7 (38,9)	0,990	0,730
	Hayır	9 (50,0)	12 (66,7)		9 (50,0)	11 (61,1)		
Kalça	Evet	3 (16,7)	1 (5,6)	0,990	8 (44,4)	4 (22,2)	**0,040***	0,400
	Hayır	15 (83,3)	17 (94,4)		10 (55,6)	14 (77,8)		
Diz	Evet	3 (16,7)	4 (22,2)	0,990	11 (61,1)	3 (16,7)	**0,030***	0,460
	Hayır	15 (83,3)	14 (77,8)		7 (38,9)	15 (83,3)		
Ayak	Evet	3 (16,7)	2 (11,1)	0,990	7 (38,9)	7 (38,9)	>0,990	0,630
	Hayır	15 (83,3)	16 (88,9)		11 (61,1)	11 (61,1)		

Tablo 6. Obezlere özgü yaşam kalitesi anketinin egzersiz eğitimi öncesi-sonrası grup içi- gruplar arası karşılaştırması

	Mat pilates	Grup içi	Reformer pilates	Grup içi	Gruplar arası
	Ort. ± SS	p	Ort. ± SS	p	p
Egzersiz eğitimi öncesi yaşam kalitesi	45,27 (21,24)	**0,010***	40,83 (18,16)	**0,010***	0,505
Egzersiz eğitimi sonrası yaşam kalitesi	48,44(20,37)		54,33 (17,72)		0,361

Ort.: Ortalama, SS: Standart Sapma, ***: p<0,05**

üzerinde anlamlı düzeyde etkili olduğu ancak olguların artması yönünde beklenen kas oranlarını azalttığı tespit edilmiştir. Bu sonucun egzersizle intramusküler yağ miktarındaki azalmaya bağlı olarak kas oranının azalabileceği ve pilates egzersizleri sürecinde olguların beslenme durumlarının dikkatli bir şekilde kontrol edilmemesi bağlı olabileceği düşünülebilir.

Obezitenin, kas iskelet sistemi üzerinde oluşturduğu enflamatuvar ve dejeneratif etkiden dolayı bireylerde sistemsel şikayetlerin artmasına neden olmaktadır. Ayrıca obez bireylerde adipoz dokunun artmasıyla oluşacak birçok biyomekaniksel değişikliğin kas iskelet sistemi sorunlarına zemin oluşturduğu belirtilmektedir (28).. Ray ve diğ. (29) yaşlı popülasyonda, kronik kas iskelet ağrısı olasılığının abdominal obezitesi olanların olmayanlara göre %83'ten daha fazla olduğunu belirtmişlerdir. Obezite ile ağrı arasında ilişki açık olarak belirlenememiş olmasına rağmen özellikle abdominal obezitenin bel ağrısı riskini artırdığı ve kişilerin günlük yaşam aktivitelerini olumsuz yönde etkilediği görülmektedir. Sonuç olarak; obez hastaların çoğunda kronik bel ağrısı olduğu ve bu hastaların kilo kontrollerine yönelik takip ve tedavilerine önem verildiğinde toplumda bel ağrısı insidansının da azalacağı ve bu konuda hasta sayısının yeterli olduğu, randomize kontrollü çalışmalara ihtiyaç olduğu belirtmektedir (30). Tsuritani ve diğ. (31) da kadınlarda kronik bel ağrısıyla yüksek VKİ arasında ilişki olmadığını tespit etmişlerdir. Bolgen-Cimen ve diğ. (32) da kronik bel ağrısı olan hastalarda obezitenin ağrı nedeni olamayacağını ifade etmişlerdir. Ceylan ve diğ.'nin (28) normal kilolu, fazla kilolu ve obez kronik bel ağrılı hastalarda obezitenin ağrı şiddeti ve özürlülük düzeyini etkilemediğini tespit etmişlerdir (33). Bizim çalışmamızda da reformer pilatesin olguların kas iskelet sistemi şikayetlerini (bel ve ayak hariç) azaltarak pozitif yönde etkili olduğu, mat pilatesin ise herhangi bir etkisinin olmadığı tespit edilmiştir. Reformer pilatesin kas iskelet sistemine ait şikayetlerin azalması yönündeki pozitif etkisinin dirençli aletlerle ve yaylı sistemler ile yapılıyor olmasının, omurgayı ve çevresindeki kasları daha iyi esneterek ve uzatarak hareket kabiliyetini artırıp kaslardaki sertlik ve gerilimi azaltarak ağrının hafifletilmesine ve azalmasına neden olması düşünülebilir.

Bizim çalışmamızda da reformer pilatesin olguların kas iskelet sistemi şikayetleri (boyun, omuz, üst sırt, dirsek, el, kalça ve diz) bölgeleri üzerine pozitif yönde etkili olduğu tespit edilmiştir. Mat pilatese göre reformer pilatesin, dirençli aletlerle ve yaylı sistemler ile yapılıyor olmasının, omurgayı ve çevresindeki kasları daha iyi esneterek ve uzatarak hareket kabiliyetini artırıp kaslardaki sertlik ve gerilimi azaltarak ağrının hafifletilmesine ve kas iskelet sistemine ait şikayetlerin azalmasına neden olduğu düşünülebilir

Yaşam kalitesi bireyin günlük rutinini kendi kendine tamamlayabilme kendine yetebilme becerisidir (34). Obezlerde depresyonun, kendini toplumdan soyutlamanın, değersizlik hissi gibi duyguların sık görüldüğü ve buna bağlı olarak kişilerin pozitif iyilik halinin bozulmasıyla yaşam kalitelerinin bozulduğu bilinmektedir (35). Aksine, obezitenin yaşam kalitesini birçok yönden olumsuz etkilediğini ancak kilo vermekle yaşam kalitesinin yükseleceğini de gösteren çalışmalar da mevcuttur (35). Rosa ve diğ. (12) tarafından yapılan çalışmada obez bireylerde kas iskelet sistemi problemlerinin yaşam kalitesini negatif yönde etkileyen bir sorun olduğu belirtilmektedir. Bu nedenle kas iskelet rahatsızlıklarının rehabilite edilebilmesi için multidisipliner ilişkinin önemli olduğu ve yeni çalışmalara ihtiyaç duyulduğu vurgulanmaktadır. Farklı disiplinlerin yer aldığı bir kilo yönetim programına katılan obez bireylerin kas iskelet ağrı profilinin araştırıldığı bir çalışmada, birden fazla kas iskelet ağrısına sahip sınıf III obez hastaların, sınıf I-II obez ve ağrısız hastalara göre uyku kalitesi yaşam kalitesini, fiziksel aktivite düzeyi ve fiziksel fonksiyonlarının daha kötü olduğu görülmektedir (35). Avusturalya'da yaşayan bireylerin (%66'ı erkek, %52'si fazla kilolu veya obez kadın) arasında VKİ ve yaşam kalitesi arasındaki ilişkinin incelendiği çalışmada normal kilolu bireylerin fazla kilolu ve obez bireylere göre daha iyi yaşam kalitelerinin olduğu görülmektedir (36). Aksine, farklı bir meta-analiz çalışmasında ise obezitenin, çocuklar ve ergenlerde genel yaşam kalitesini önemli ölçüde düşürdüğü vurgulanmaktadır (34). Ancak, obezitenin yaşam kalitesini birçok yönden olumsuz etkilemesine rağmen kilo vermekle pozitif yönde etkilediğini gösteren çalışmalar da mevcuttur (35). Bizim çalışmamızda mat pilates ve reformer pilates eğitiminin obez kadınların yaşam kalitelerini anlamlı derecede iyileştirdiği saptanmıştır. Olguların egzersiz sonrası vücut ağırlıklarının ve VKİ'lerdeki azalmanın kendilerine olan güvenlerinin artmasına, moral ve motivasyonlarının düzelmesine ve beden algılarının değişmesine neden olarak yaşam kalitelerini pozitif yönde etkilenmesine neden olabileceği düşünülmektedir.

SONUÇ

Sonuç olarak; mat pilates ve reformer pilatesin vücut kompozisyonu ve yaşam kalitesi üzerinde pozitif yönde etkili olduğu ve birbirlerine karşı üstünlüklerinin olmadığı, kas iskelet sistemi şikayetleri üzerine ise sadece reformer pilatesin önemli derecede etkili olduğu tespit edilmiştir. Çalışmamızın güçlü yanları; pilates eğitiminin pilates eğitimi almış tecrübeli bir fizyoterapist tarafından yapılması, çalışma süresi ve seansların literatürle uyumlu olmasıdır.

Çalışmanın Kısıtlılıkları

Çalışmamızın zayıf yönleri; çalışmamızdaki katılımcıların tamamen kadınlardan olması ve örneklemin büyük olmaması, kontrol grubunun olmaması ve olguların ağrı şiddetinin daha objektif bir yöntem kullanılarak belirlenmemiş olmasıdır.

Çalışmamızın sonuçları mat pilates ve reformer pilates egzersizlerinden oluşan eğitim programının bel çevresi, kalça çevresi, bel/kalça oranı, yağ oranı, visseral yağ oranı, vücut ağırlığı ve VKİ ön test-son test değerlerini azalttığını gösterdi. Diğer taraftan mat pilates ve reformer pilates arasında vücut kompozisyonu açısından eğitim öncesi ve sonrası bel çevresi, bel/kalça oranı değerleri ile eğitim sonrası kas oranı değerleri arasında anlamlı fark tespit edildi. Reformer pilates eğitiminin kas iskelet sistemi şikayetleri eğitim öncesi ve sonrası değerlerini azalttığı, mat pilatesin ise etkili olmadığı görüldü. Yaşam kalitesi üzerine ise mat pilates ve reformer pilatesin anlamlı pozitif etkilerinin olduğu ancak birbirlerine karşı üstünlüğünün olmadığı saptandı. Sonuç olarak; obezite tedavisinde kadınların kas iskelet sistemi şikayetlerini azaltmak, vücut kompozisyonunu geliştirmek ve yaşam kalitelerini artırmak için mat ve reformer pilates egzersizleri önerilebilir. Ayrıca, obezite ile mücadele kapsamında halk sağlığına yönelik eylem planları içerisinde fizyoterapistler tarafından reçete edilen uygun pilates egzersizleri olarak dikkate alınabilir.

Etik: Çalışma protokolü Üsküdar Üniversitesi Girişimsel Olmayan Araştırmalar Etik Kurulu tarafından 22.03.2023 tarihli 2023/03 sayılı karar numarası ile onaylanmış ve Helsinki Bildirgesi prensiplerine uygun olarak yürütülmüştür.

Hasta Onamı: Çalışmaya katılmayı kabul eden bireylere çalışma hakkında detaylı bilgi verildikten sonra onam formu doldurulup imzalatılmıştır. Hasta onamı alınmıştır.

Destekleyen Kuruluş: Bulunmamaktadır.

Çıkar Çatışması: Herhangi bir kişi, enstitü, kurum ile çıkar çatışması yoktur.

Yazar katkıları: Fikir/Kavram- MK, DD; Tasarım- MK, DD; Denetleme/Danışmanlık-DD; Kaynaklar ve Fon Sağlama- MK, DD; Materyaller- MK, DD; Veri Toplama ve/veya Veri İşleme- MK; Analiz ve/veya Yorumlama MK, DD; Literatür Taraması- MK, DD; Makale Yazımı- MK, DD; Eleştirel İnceleme- DD.

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Teşekkür: Yazarlar, bu makalenin hazırlanması sürecinde veri işleme, literatür tarama ve tasnif çalışmalarındaki katkılarından dolayı Türkiye Eğitim Derneği (TED) İstanbul Vakfı Koleji öğrencisi Oya Demirci'ye teşekkür ederler.

KAYNAKLAR

1. Wharton S, Lau DC, Vallis M, Sharma AM, Biertho L, Campbell-Scherer D, et al. Obesity in adults: a clinical practice guideline. CMAJ. 2020;192(31): E875-91.
2. Obesity and overweight: fact sheet [Internet]. Geneva: WHO; 2016 [cited 2023 Dec 24]. Available from: http://www.who.int/mediacentre/factsheets/fs311/en/
3. Çukur A, Arıtı Erdem İ. The role of obesity taxes in the fight against obesity: an evaluation for Turkey. Sayıştay Dergisi. 2017;(106):121-46.
4. U.S. Department of Health and Human Services. The Surgeon General's call to action to prevent and decrease overweight and obesity [Internet]. Washington, DC: U.S. Department of Health and Human Services; 2001 [cited 2023 Dec 24]. Available from: https://www.cdc.gov/nccdphp/dnpa/pdf/calltoaction.pdf
5. Chooi YC, Ding C, Magkos F. The epidemiology of obesity. Metabolism. 2019;92:6-10.
6. Di Rosa C, Lattanzi G, Taylor SF, Manfrini S, Khazrai YM. Very low calorie ketogenic diets in overweight and obesity treatment: effects on anthropometric parameters, body composition, satiety, lipid profile and microbiota. Obes Res Clin Pract. 2020;14(6):491-503.
7. Schmidt-Grund R, Rheinländer B, Kaidashev E, Lorenz M, Grundmann M, Fritsch D, Schubert M, Schmidt H, Herzinger C. Influence of Pilates method on nonspecific lumbar pain. Journal of the Korean Physical Society. 2008;53(1):88.
8. Kloubec J, Banks AB. Pilates and physical education: A natural fit. Journal of Physical Education, Recreation & Dance. 2013;75(4):34-7.
9. Şimşek D, Katırcı H. The influence of pilates exercises on postural stability and sports performance: a systematic review of the literature. Nigde University Journal of Physical Education And Sport Sciences. 2011;5(2):58-70.
10. Özkan A, Köklü Y, Kayıhan G, Alemdaroğlu U, Ersöz G. The role of physical activity and exercise in prevention and treatment of obesity. Uluslararası Hakemli Akademik Spor ve Sağlık ve Tıp Bilimleri Dergisi.2013;3(7):48-63.
11. Uzun A, Demir B. Effect of pilates and reformer exercises on body composition. International Journal of Applied Exercise Physiology. 2020;9(1):148-56.
12. Rosa S, Martins D, Martins M, Guimarães B, Cabral L, Horta L. Body mass index and musculoskeletal pain: a cross-sectional study. Cureus. 2021;13(2):e13400.
13. Zadro JR, O'Leary S, Maher C, et al. The effectiveness of pilates exercise in individuals with chronic low back pain: a systematic review and meta-analysis of randomized controlled trials. Eur Spine J. 2018;27(2):267-78.
14. Karadenizli Zİ, Kambur B. The effects of reformer pilates exercises on thigh circumference and harmstring flexibility on women. Inonu University, Journal of Physical Education and Sport Sciences. 2016;3(3):48-62.
15. Tamer K. Sporda fiziksel-fizyolojik performansın ölçülmesi ve değerlendirilmesi. 2. baskı. Ankara: Bağırgan Yayımevi; 2000.
16. Şavkın R. Pilates eğitiminin vücut kompozisyonuna etkisi. Yüksek lisans tezi. Pamukkale Üniversitesi, Sağlık Bilimleri Enstitüsü, Fizik Tedavi ve Rehabilitasyon Anabilim Dalı; 2014.
17. Kuorinka I, Jonsson B, Kilbom A, Vinterberg H, Biering-Sørensen F, Andersson G, et al. Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. Appl Ergon. 1987;18(3):233-7.
18. Dawson AP, Steele EJ, Hodges PW, Stewart S. Development and test-retest reliability of an extended version of the Nordic Musculoskeletal Questionnaire (NMQ-E): a screening instrument for musculoskeletal pain. J Pain. 2009;10(5):517-26.
19. Çıray Gündüzoğlu N, Fadıloğlu Ç, Yılmaz C. Obezlere özgü yaşam kalitesi ölçeğinin geçerlilik ve güvenirliğinin incelenmesi. Anadolu Psikiyatri Derg. 2014;15:63-8.
20. Şavkin R, Aslan UB. The effect of Pilates exercise on body composition in sedentary overweight and obese women. J Sports Med Phys Fitness. 2017;57(11):1464-70.

21. Öz B, Karataş A, Akar ZA, Koca SS. Obesity and musculoskleteal system. Firat Med J. 2018;23(Suppl):42-7.

22. Cakmakçi O. The effect of 8 week pilates exercise on body composition in obese women. Coll Antropol. 2011;35:1045-50.

23. Liman N, Atalay Güzel N. The effects of aerobic-step and pilates exercise on strength, flexibility, anaerobic power, balance and body composition. Gazi BESBD. 2008;XIII(4):3-12.

24. Vaquero-Cristóbal R, Alacid F, Esparza-Ros F, Muyor JM, López-Miñarro PÁ. Efectos de un programa de 16 semanas de pilates mat sobre las variables antropométricas y la composición corporal en mujeres adultas activas tras un corto proceso de desentrenamiento [The effects of 16-weeks pilates mat program on anthropometric variables and body composition in active adult women after a short detraining period]. Nutr Hosp. 2015;31(4):1738-47. Spanish.

25. Altıntaç D. Pilates egzersizlerinin fiziksel uygunluk üzerine etkileri. Yüksek lisans tezi. Marmara Üniversitesi, Sağlık Bilimleri Enstitüsü; 2006.

26. Wang Y, Chen Z, Wu Z, Ye X, Xu X. Pilates for overweight or obesity: a meta-analysis. Front Physiol. 2021;12:643455.

27. Schmidt AC, de Oliveira Herzinger P, Matias DP, Welling LC. Influence of pilates method on nonspecific lumbar pain. Arquivos Brasileiros de Neurocirurgia. 2020;39(4):300-5.

28. Ceylan M, Başkurt Z, Başkurt F. The effect of obesity on physical performance in patients with chronic low back pain. CBU-SBED. 2022;9(2):186-93.

29. Ray L, Lipton RB, Zimmerman ME, Katz MJ, Derby CA. Mechanisms of association between obesity and chronic pain in the elderly. Pain. 2011;152(1):53-9.

30. Okifuji A, Bradshaw DH, Olson C. Evaluating obesity in fibromyalgia: neuroendocrine biomarkers, symptoms, and functions. Clin Rheumatol. 2009;28(4):475-8.

31. Tsuritani I, Honda R, Noborisaka Y, Ishida M, Ishizaki M, Yamada Y. Impact of obesity on musculoskeletal pain and difficulty of daily movements in Japanese middle-aged women. Maturitas. 2002;42(1):23-30.

32. Bolgen-Cimen O, Arıncı-Yücel N, Karabiber M, Erdoğan C. Role of obesity in low back pain related disability. West Indian Med J. 2007;56(3):252.

33. Hansen D. Exercise therapy in adult individuals with obesity. Nova Science. 2013.

34. Han TS, Tijhuis MA, Lean ME, Seidell JC. Quality of life in relation to overweight and body fat distribution. Am J Public Health. 1998;88(12):1814-20.

35. Yıldız S, Çetinkaya F. Obesity and quality of life study in adults. Ahi Evran Med J. 2020;4(2):29-34.

36. Hassan MK, Joshi AV, Madhavan SS, Amonkar MM. Obesity and health-related quality of life: a cross-sectional analysis of the US population. Int J Obes Relat Metab Disord. 2003;27(10):1227-32.

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THE RELATIONSHIP BETWEEN HANDGRIP STRENGTH AND PHYSICAL ACTIVITY BARRIERS IN PATIENTS WITH CHRONIC KIDNEY DISEASE UNDERGOING HEMODIALYSIS

ABSTRACT

Purpose: The aim of this study is to investigate the relationship between handgrip strength (HGS) and physical activity barriers in patients with chronic kidney disease (CKD) undergoing hemodialysis.

Methods: This cross-sectional and descriptive study was conducted with 78 patients with CKD receiving treatment in the hemodialysis unit of a hospital located in southern Türkiye. An individual information form, the Physical Activity Barriers Questionnaire and HGS results obtained from a digital hand dynamometer were used to collect data.

Results: The participants had a mean age of 56.85±12.17 years, with an equal distribution of males and females. The HGS values of male and employed patients were higher than the values of the others ($p<0.05$). The physical activity barriers were higher in those who were married, female, literate/primary school graduate, unemployed and had an income less than their expenses ($p<0.05$). Moreover, participants' HGS was associated with their physical activity barriers ($r=-0.246$, $p<0.05$).

Conclusion: This study revealed weak correlations between lower HGS and higher physical activity barriers in CKD patients undergoing hemodialysis. CKD patients who were female, married, and had a lower education or income level in particular faced greater physical activity barriers. Higher age and body mass index were associated with increased barriers, while employed patients had better HGS. These findings highlight the need for targeted interventions addressing socio-economic and clinical factors to improve physical activity in this population.

Keywords: Chronic kidney disease, Handgrip strength, Hemodialysis, Physical activity barriers

HEMODİYALİZ TEDAVİSİ GÖREN KRONİK BÖBREK YETMEZLİĞİ OLAN HASTALARDA EL KAVRAMA GÜCÜ İLE FİZİKSEL AKTİVİTE ENGELLERİ ARASINDAKİ İLİŞKİ

ÖZ

Amaç: Bu çalışma, hemodiyaliz alan kronik böbrek hastalığı (KBH) olan hastalarda el kavrama kuvveti (EKK) ile fiziksel aktivite engelleri arasındaki ilişkiyi araştırmayı amaçladı.

Yöntem: Kesitsel ve tanımlayıcı tipteki bu çalışma, Türkiye'nin güneyindeki bir hastanenin hemodiyaliz ünitesinde tedavi gören 78 KBH hastası ile yürütüldü. Veri toplamak için bireysel bilgi formu, fiziksel aktivite engelleri ölçeği ve dijital el dinamometresinden elde edilen EKK sonuçları kullanıldı.

Bulgular: Katılımcıların yaş ortalaması 56,85±12,17 olup, kadın ve erkek sayısı eşittir. Erkeklerin ve çalışan hastaların EKK diğerlerine göre daha yüksekti ($p<0,05$). Evli, kadın, okuryazar/ilkokul mezunu, geliri giderinden az olan ve çalışmayan bireylerde fiziksel aktivite engellerinin daha yüksek olduğu belirlendi ($p<0,05$). Ayrıca katılımcıların EKK ile fiziksel aktivite engelleri ilişkiliydi ($r=-0,246$, $p<0,05$).

Sonuç: Bu çalışma, hemodiyaliz alan KBH hastalarında düşük EKK ile yüksek fiziksel aktivite engelleri arasında zayıf bir ilişki olduğunu ortaya koymuştur. Özellikle kadınların, evli bireylerin, düşük eğitim veya gelir düzeyine sahip olanların daha fazla fiziksel aktivite engeliyle karşılaştığı görüldü. Artan yaş ve vücut kütle indeksi, engellerin yükselmesiyle ilişkilendirilirken, çalışan hastalar daha iyi EKK sergiledi. Bu bulgular, bu popülasyonda fiziksel aktiviteyi iyileştirmek için sosyo-ekonomik ve klinik faktörlere yönelik hedefli müdahalelerin gerekliliğini vurgulamaktadır.

Anahtar Kelimeler: Kronik böbrek hastalığı, Kas gücü, Hemodiyaliz, Fiziksel aktivite engelleri

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INTRODUCTION

Chronic kidney disease (CKD) is a progressive disease characterized by irreversible renal function impairment that often develops in elderly people. CKD is mainly associated with a decreased glomerular filtration rate (GFR). As the disease progresses (GFR <15), renal functions become inadequate to meet the needs of the body and the end-stage kidney disease (ESKD) occurs (1). One of the most common treatment methods in patients with ESKD is hemodialysis (2). It is recommended that patients undergoing hemodialysis engage in moderate physical activity at least 3-4 days a week (3). However, physical activity levels are significantly lower in CKD patients who undergoing hemodialysis. They typically remain physically inactive for approximately four hours per hemodialysis session, three times per week. In addition, patients may feel fatigue and weakness after a hemodialysis session, resulting in physical inactivity throughout the day. Physical inactivity in patients with CKD undergoing hemodialysis leads to accelerated physical deformation and decreased capacity for independence (4). Decreased physical activity is associated with higher morbidity and mortality (5,6).

Perceived benefits and barriers are important concepts of the health promotion model. Individual perceptions of physical activity barriers may also affect physical activity behavior. Therefore, it is crucial to understand individual perceptions of barriers in order to elevate physical activity levels (7-9). While physical activity barriers have been well-studied in other populations, limited evidence exists for CKD patients. Common barriers include time constraints, safety concerns (e.g., pain/injury risk), comorbidities, and environmental factors (10). The interaction between personal, environmental, and behavioral determinants of physical activity behavior necessitates the systematic identification of modifiable barriers to enhance physical activity adherence. This approach enables the development of culturally adapted, theoretically grounded interventions aimed at optimizing physical activity attitudes and engagement in CKD populations (11).

Increased muscle strength is known to motivate people to continue engaging in physical activity (12). By contrast, inadequate physical activity is associated with increased mortality because it contributes to a decrease in muscle strength. Moreover, CKD patients tend to have low muscle strength (13). For this reason, muscle strength is frequently evaluated when examining the clinical conditions of patients with CKD (14). Handgrip strength (HGS), which is one of the methods used to evaluate muscle strength in the clinic, is also an indicator of the body's total muscle strength (15). A systemic review highlighted that HGS was a useful tool for assessing muscle mass in CKD patients undergoing dialysis (14). A study conducted in China with 10.407 individuals showed that HGS decreased as kidney function declined (16). The aim of this study is to investigate the relationship between HGS and physical activity barriers in patients with CKD undergoing hemodialysis.

METHOD

Study Design and Sample

This cross-sectional and descriptive study was conducted in the hemodialysis unit of a state hospital located in southern Türkiye between May 2022 and July 2022. The study adhered to the Strengthening the Reporting of Observational Studies in Epidemiology checklist for cross-sectional studies.

The sample size calculation application developed by Raosoft Inc. was used to determine the sample size. It was known that there were approximately 80 patients receiving treatment in the unit during the study period. It has been reported that the prevalence of physical activity barriers in CKD patients ranges between 66-89% (17). However, in this calculation application, prevalence values greater than 50% are generally accepted as 50%. According to this information, the minimum sample size to be included in the study was determined as 67 (margin error=5%, confidence interval=95%, population=80).

The inclusion criteria for the patients were determined as follows; being voluntary to participate in the study, being 18 years of age or older, receiving hemodialysis treatment for more than 3 months, not having any physical integrity that would prevent physical activity (such as amputation), and having no communication or comprehension problems.

All patients who met the inclusion criteria during the study period and granted informed consent (n=78) were included in the study using consecutive sampling method. This sample size exceeds the minimum required sample size (n=67), as determined by power analysis. This approach ensured the most comprehensive representation of the target population in our single-center study. Additionally, maintaining statistical power in subgroup analyses of categorical variables (e.g., gender, marital status, and educational status) was prioritized. Data collection forms were applied to the patients who agreed to participate in the study after they were informed about the study.

Data Collection Tools

The researchers collected data via face-to-face interviews before hemodialysis. Individual information form, Physical Activity Barriers Questionnaire (PABQ), and HGS measurements were used to collect data. It took approximately 20 minutes for each patient to collect data.

The researchers prepared an individual information form by reviewing the relevant literature (2,18,19). This form has

questions about the participants' age, gender, income, marital status, educational level, employment status, and body mass index (BMI). The weights of the patients were measured by the nurses working in the unit before hemodialysis. The researchers measured heights of the patients before the hemodialysis procedure with a 300-cm inflexible tape measure that was marked by 1-cm intervals.

The PABQ was developed by Ibrahim et al. (20), to determine the conditions seen as barriers to physical activity. This 5-point Likert-type scale (1=strongly disagree, 5=strongly agree) consists of 24 items and three subscales (personal, social environment, and physical environment). All items in the scale are positively expressed and high scores indicate a high probability of physical activity barriers. The Cronbach's alpha internal consistency coefficient of the original version of the scale was found to be 0.85 for the overall scale and range between 0.68 and 0.74 for its subscales. The Turkish validity and reliability study of the scale was conducted by Yurtçiçek et al. (19), with 300 healthy individuals. However, since it is reported that the Turkish version could be used in different populations, we used it in CKD patients in the present study. In its Turkish version with 22 items, the personal subscale includes items 1-14, the social environment subscale includes items 15-17, and the physical environment subscale includes items 18-22. The Turkish version of PABQ demonstrated an excellent internal consistency, and Cronbach's alpha coefficient was found to be 0.87 for the overall scale. For the subscales, Cronbach's alpha coefficient ranged from 0.53 to 0.85, indicating acceptable to good internal consistency across different domains of the scale.

The HGS was measured by the physiotherapists in the sample group using an adjustable digital high-precision hand dynamometer (Commander Echo Grip Dynamometer, JTech Medical, Midvale, Utah, USA). The device, which has a measurement sensitivity of 0.1 kg, can automatically calibrate itself with each opening. The measurements were performed on the fistula-free hand immediately before the dialysis procedure so that the patients' treatment would not be disrupted. The participants were asked to perform a single trial using the dynamometer prior to the actual assessment so they could familiarize themselves with the device; thereby, allowing accurate measurements to be obtained. The dynamometer handle was fixed to the second level and the measurements were performed in a standardized manner with patients seated in a semi-sitting position, holding their elbow in slight flexion and positioned close to the trunk/body. They were asked to grip the dynamometer with maximum force for a duration of 3 seconds upon a voice command (come on, squeeze harder, etc.). Two measurements were performed with 1-minute rest intervals. For analysis, the highest HGS value obtained from the patients was recorded in kilograms (21).

Ethical Considerations

In order to conduct the study, the approval from the Gaziantep University Clinical Trials Ethics Committee (date: 09.03.2022, approval number: 2022/82) and permission from the Kilis Provincial Health Directorate (date: 21.04.2022, number: E-83362427-604.02.02) were obtained. The study protocol was thoroughly explained to all participants, and both written and verbal informed consent were obtained from them. Written permission was obtained from the responsible author to use the PABQ in the study.

Statistical Analysis

The data were evaluated using the SPSS 25.0 software. Descriptive data were represented in frequency, percentage, mean, and standard deviation. The Shapiro-Wilk test was run to check whether or not continuous variables were normally distributed. For normally distributed continuous variables, comparisons between groups were conducted using the Independent Samples t-test or one-way ANOVA, as appropriate. Bonferroni correction was applied to determine which group caused the significant difference resulting from the ANOVA test. Effect sizes were calculated to assess the clinical significance of differences between the groups. Cohen's *d* (small=0.10, medium=0.25, large =0.50) was calculated for mean differences of continuous variables, and partial eta-squared (η^2) (small=0.01, medium=0.06, large =0.14) was calculated for significant differences in ANOVA analyses (22). The Pearson correlation test was run to determine the correlations between continuous variables (negligible: 0.00-0.10, weak: 0.10-0.39, moderate: 0.40-0.69, strong: 0.70-0.89, very strong: 0.90-1.00) (23). Statistical significance level was accepted as $p<0.05$.

RESULTS

Results of the study indicated that the number of female and male participants was equal, and their mean age was 56.9±12.2 years. The majority of the participants were married (89.7%), literate/primary school graduates (90%), had an income less than expenses (60.3%), and were unemployed (88.5%). The mean BMI value of the participants was 28.4±5.7 (Table 1).

HGS value was higher in those who were male (25.6±9.8 kg) ($p<0.001$, d=1.30) and employed (28.5±12.4 kg) ($p=0.006$, d=0.88). The married participants had higher scores in personal barriers subscale (44.3±12) ($p=0.027$, d=0.66). Those who were female (17.5±3.9) ($p<0.001$, d=-0.79), literate/primary education graduate (16.3±4.1) ($p=0.041$, $\eta^2=0.08$), and had an income less than their expenses (17.1±3.9) ($p=0.008$, $\eta^2=0.12$) had higher scores in physical environmental barriers subscale. In addition, unemployed ones had higher scores in personal barriers subscale (44.6±11.6) ($p=0.049$, d=-0.74), physical

environmental barriers subscale (16.4±3.9) (p=0.002, d=-0.99), and overall PABQ (69±14.2) (p=0.034, d=-0.80) compared to the other participants (Table 2).

When the distribution of the participants' responses to PABQ was examined, it was determined that in the physical activity barriers subscale, the highest scores were obtained from Item 3 (I have health problems that prevent me from being physically active) (4.10±1.35), Item 4 (physical activity is difficult and tiring) (3.94±1.29), and Item 1 (I do not have extra energy to do physical activity after I finish my work) (3.93±1.44). In the physical activity barriers subscale, the participants obtained the lowest scores from Item 5 (I look funny and feel embarrassed when I do physical activities) (1.81±1.24), Item 17 (I do not have free time to exercise or do physical activities because of my work) (1.91±1.37), and Item 8 (I think physical activity is not beneficial to my health) (1.99±1.32), respectively. Table 3 shows the distribution of their other responses to PABQ.

When the correlation between some characteristics of the participants, HGS and physical activity barriers was examined, it was determined that HGS had a negative weak-moderate correlation with PABQ total score (r=-0.246, p=0.030) and age (r=-0.273, p=0.016). In addition, age (r=0.380, p=0.001) and BMI (r=0.233, p=0.040) of the participants had a positive weak-moderate correlation with total PABQ and some of its subscales (p<0.05) (Table 4).

Table 1. Descriptive characteristics of the participants (n=78)

Variables	n	%
Gender		
Male	39	50
Female	39	50
Marital status		
Married	70	89.7
Single	8	10.3
Educational background		
Literate/primary education	71	90
High school	5	6.4
Higher education	2	2.6
Income status		
Income less than expense	47	60.3
Income equal to expense	28	35.9
Income more than expense	3	3.8
Employment status		
Employed	9	11.5
Unemployed	69	88.5
Age (years)	56.9±12.2	
BMI (kg/m²) (M ± SD)	28.4±5.7	

BMI: Body Mass Index, M: Mean, SD: Standard Deviation.

DISCUSSION

Inadequate physical activity is a common condition in patients with CKD undergoing hemodialysis. Fatigue, decreased muscle strength, and perceived barriers to physical activity after hemodialysis are associated with inadequate physical activity in patients with CKD (24). In their study, Moorman et al. (25), reported that fatigue was the most common physical activity barrier in CKD patients. It is known that individuals with a high perception of barriers to physical activity avoid engaging in physical activity (26). The present study conducted on CKD patients in the southern Türkiye revealed that patients who were female, married, had a low education level and had an income less than their expenses had high physical activity barriers. Individuals with low educational and income levels often do not engage in sufficient physical activity, primarily because they do not consider it as a priority in their lives (27). Therefore, simple and understandable educational materials (brochures, videos) should be used to raise awareness of CKD patients with low educational levels on the importance of physical activity. Furthermore, women with low socio-economic status tend to have insufficient physical activity levels since social expectations such as household chores and childcare lead them to allocate little time for exercise (28,29). For socioeconomically disadvantaged patients and women, free or affordable physical activity opportunities (e.g., free gyms, hospital-based rehabilitation programs) should be provided. A study by Calogiuri and Elliott (30) reported that physical activity in gyms can motivate people because gyms encourage socialization. This may provide an important opportunity for CKD patients with insufficient financial means to engage in physical activity.

CKD patients undergoing hemodialysis tend to have decreased muscle strength over time, thus negatively affecting their engagement in physical activities in the future (26). In the present study, the decrease in muscle strength and the increase in physical activity barriers were correlated with each other in patients with CKD receiving hemodialysis. In addition, when the distribution of their responses to the PABQ was examined, it was found that the most important physical activity barriers were related to health problems, lack of energy and fatigue. Other health problems that are caused by the disease such as muscle strength loss and lack of energy cause a vicious cycle. This condition places patients with CKD at risk of physical exhaustion and poses a very serious obstacle to participation in physical activity or exercise. Engaging in physical activity becomes significantly more challenging for these patients after they reach that threshold (31). Low-intensity (walking, water exercises) and gradually increasing physical activities

should be recommended for CKD patients who complain of low energy and fatigue (32). For patients suffering from fatigue, energy-saving techniques and rest periods should be scheduled before physical activity. In their study, Farragher et al. (33), determined that individual energy conservation programs applied to chronic dialysis patients were beneficial in improving fatigue-related outcomes. For patients with CKD, interventions should be made to make physical activity or exercise a lifestyle in the early stages of the disease when muscle loss and the burden of the disease are low. The support provided by healthcare personnel to CKD patients undergoing hemodialysis is extremely important in encouraging them to engage in physical activity. A study examining the correlation between the attitudes of healthcare professionals and barriers to physical activity reported that the non-proactive attitude of healthcare professionals reduced physical activity in patients undergoing hemodialysis. Moreover, patients with fewer disabilities would benefit the most from the attitude of proactive staff (34). In hemodialysis units, the presence of physiotherapists specialized in exercise, along with doctors and nurses, may be effective in planning and encouraging exercise programs for patients undergoing hemodialysis.

Table 2. Comparison of physical activity barriers and handgrip strength according to descriptive characteristics of the participants (n=78)

Variables	Handgrip strength (kg) (M ± SD)	Physical Activity Barriers Questionnaire			
		Personal (M ± SD)	Social environment (M ± SD)	Physical environment (M ± SD)	Total (M ± SD)
Gender					
Male	25.6±9.8	42.5±13	8.4±3.3	14.3±4.2	65.1±15.2
Female	14.7±6.5	44.9±10.2	8±3.2	17.5±3.9	70.4±13.2
p-value[a]	**<0.001*****	0.381	0.648	**<0.001*****	0.107
Effect size	d=1.30	-	-	d=-0.79	
Marital status					
Married	20.5±10.0	44.3±12	8.2±3.3	16±4.3	68.4±14.7
Single	16.7±8.6	38±6	8.7±1.9	15.4±4.7	61.8±10.8
p-value[a]	0.265	**0.027***	0.866	0.713	0.215
Effect size	-	d=0.66	-	-	-
Educational background					
Literate/primary education[1]	20.2±10.2	44.5±11.8	7.9±3.1	16.3±4.1	68.8±14.5
High school[2]	21.3±3	35.2±7.4	11.2±3.7	12.8±5.4	59.2±11.4
Higher education[3]	15.3±13.1	34±1.4	9.5±2.1	10.5±2.1	54±1.4
p-value[b]	0.761	0.111	0.073	**0.041*** 1>2=3	0.140
Effect size	-	-	-	η^2=0.08	-
Income status					
Income less than expense[1]	20.7±9.9	45.3±10.6	8.3±3.4	17.1±3.9	70.7±12.7
Income equal to expense[2]	17.9±9.4	41.4±12.7	8.3±2.7	14.3±4.4	64±15
Income more than expense[3]	32.1±5.4	38.7±17.6	6±4.4	12.3±4.5	57±26
p-value[b]	0.051	0.282	0.485	**0.008**** 1>2=3	0.059
Effect size	-	-	-	η^2=0.12	
Employment status					
Employed	28.5±12.4	36.6±10.1	9.8±3.4	11. 9±5.1	58.2±12.6
Unemployed	19.0±9.1	44.6±11.6	78±3.1	16.4±3.9	69±14.2
p-value[a]	**0.006****	**0.049***	0.114	**0.002****	**0.034***
Effect size	d=0.88	d=-0.74	-	d=-0.99	d=-0.80

[a]: Independent Samples t-tests, [b]: One-Way ANOVA, d: Cohen' d, η^2: Partial Eta-Squared, *: p<0.05, **: p<0.01, ***: p<0.001, M: Mean, SD: Standard Deviation.

The present study indicated that there was a correlation between the increasing BMI and age of the participants and the increase in physical activity barriers. It is known that the lack of self-discipline, pain, discomfort and time constraints in overweight individuals are correlated with the increasing level of physical inactivity (35). Physical activity barriers should be reduced by giving appropriate motivation to CKD patients by a multidisciplinary team including physicians, physiotherapists, and nurses. Furthermore, comorbid conditions in CKD patients may cause physical activity barriers. It is known that aging causes more comorbidities physiologically and psychologically (10). Therefore, in studies aiming to reduce physical activity barriers, comorbid conditions, especially in elderly patients, should be carefully examined.

Limitations

This study has some limitations. Although there was a negative correlation between PABQ and HGS, the power of the correlation was weak. This weakness may be associated with the low HGS of the population in the study. In addition, the presence of small sample groups in some categorical variables may have caused weak-moderate correlations (e.g., higher education n=2, income more than expenses n=3).

CONCLUSION

Patients with CKD who were married, female, had a low education level, had an income less than their expenses, and were unemployed had higher physical activity barriers. In addition, as patients' age and BMI increased, physical activity barriers increased. The most frequently expressed physical activity barriers were related to patients' health problems, fatigue, and low energy complaints. HGS in CKD patients undergoing hemodialysis was higher in those who were male and employed. HGS was associated with physical activity barriers in these patients.

Table 3. Distribution of participants' responses to items of Physical Activity Barriers Questionnaire

Item number	Statement	Mean	Standard deviation	Minimum	Maximum
3	I have health problems that prevent me from being physically active.	4.10	1.35	1.00	5.00
4	Physical activity is difficult and tiring.	3.94	1.29	1.00	5.00
1	I don't have extra energy to do physical activity after I finish work.	3.94	1.44	1.00	5.00
2	I feel physically ill and uncomfortable when I exercise.	3.90	1.34	1.00	5.00
22	I don't have extra money to go to the gym or buy sports equipment and clothing.	3.83	1.52	1.00	5.00
21	Hot or rainy days prevent me from doing physical activity.	3.60	1.43	1.00	5.00
11	The intensity of exercise required to achieve health benefits is too high for me.	3.53	1.41	1.00	5.00
16	I don't have friends with whom I can do physical activities.	3.37	1.74	1.00	5.00
14	My body shape prevents me from doing physical activities.	3.33	1.58	1.00	5.00
13	I lack self-discipline/initiative to do physical activity.	3.13	1.34	1.00	5.00
6	I am not interested in exercise or doing physical activities.	3.12	1.48	1.00	5.00
9	I am afraid of getting injured while exercising and I am concerned about my safety.	3.10	1.62	1.00	5.00
20	I don't know how to use sports equipment and skills in physical activities.	3.08	1.54	1.00	5.00
15	My family/friends don't encourage me to do physical activities.	2.91	1.68	1.00	5.00
10	I'm too lazy to do physical activities.	2.76	1.43	1.00	5.00
19	The sports facilities or areas are too far away and I don't have any transportation.	2.71	1.73	1.00	5.00
18	There are no areas/facilities or opportunities for physical activities in my neighborhood.	2.69	1.74	1.00	5.00
12	I am not skilled in physical activities.	2.68	1.34	1.00	5.00
7	I do not enjoy physical activities or exercise.	2.35	1.39	1.00	5.00
8	I do not think physical activities are good for my health.	1.99	1.32	1.00	5.00
17	I do not have free time to exercise or do physical activities because of my job.	1.91	1.37	1.00	5.00
5	I look funny and feel embarrassed when I do physical activities.	1.81	1.24	1.00	5.00

Table 4. Correlation between some characteristics of the participants, handgrip strength and physical activity barriers (n=78)

Variables		1	2	3	4	5	6	7
1. Age (years)	r	1						
	p	-						
2. BMI (kg/m²)	r	0.206	1					
	p	0.071	-					
3. Handgrip strength	r	**-0.273***	0.019	1				
	p	0.016	0.867	-				
PABQ								
4. Personal	r	**0.343****	**0.280***	-0.204	1			
	p	0.002	0.013	0.074	-			
5. Social environment	r	0.121	-0.211	-0.122	0.030	1		
	p	0.293	0.063	0.286	0.794	-		
6. Physical environment	r	**0.251***	0.176	-0.178	**0.404****	-0.033	1	
	p	0.027	0.123	0.119	0.000	0.776	-	
7. Total	r	**0.380****	**0.233***	**-0.246***	**0.939****	**0.237***	**0.620****	1
	p	0.001	0.040	0.030	0.000	0.037	0.000	-

*: p<0.05, **: p<0.01, r: Pearson Correlation Test, BMI: Body Mass Index, PABQ: Physical Activity Barriers Questionnaire.

Ethics: The approval from the Gaziantep University Clinical Trials Ethics Committee (date: 09.03.2022, approval number: 2022/82) and permission from the Kilis Provincial Health Directorate (date: 21.04.2022, number: E-83362427-604.02.02) were obtained.

Informed Consent: The study protocol was thoroughly explained to all participants, and both written and verbal informed consent were obtained from them.

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REFERENCES

1. Levey AS, Becker C, Inker LA. Glomerular filtration rate and albuminuria for detection and staging of acute and chronic kidney disease in adults: a systematic review. JAMA. 2015;313(8):837-46.
2. Tsai YC, Chen HM, Hsiao SM, Chen CS, Lin MY, Chiu YW, et al. Association of physical activity with cardiovascular and renal outcomes and quality of life in chronic kidney disease. PLoS One. 2017;12(8):e0183642.
3. Lambert K, Lightfoot CJ, Jegatheesan DK, Gabrys I, Bennett PN. Physical activity and exercise recommendations for people receiving dialysis: a scoping review. PLoS One. 2022;17(4):e0267290.
4. Jayaseelan G, Bennett PN, Bradshaw W, Wang W, Rawson H. Exercise Benefits and barriers: the perceptions of people receiving hemodialysis. Nephrol Nurs J. 2018;45(2):185-219.
5. Johansen KL, Chertow GM, Kutner NG, Dalrymple LS, Grimes BA, Kaysen GA. Low level of self-reported physical activity in ambulatory patients new to dialysis. Kidney Int. 2010;78(11):1164-70.
6. Tentori F, Elder SJ, Thumma J, Pisoni RL, Bommer J, Fissell RB, et al. Physical exercise among participants in the Dialysis Outcomes and Practice Patterns Study (DOPPS): correlates and associated outcomes. Nephrol Dial Transplant. 2010;25(9):3050-62.
7. Darawad MW, Khalil AA. Jordanian dialysis patients' perceived exercise benefits and barriers: a correlation study. Rehabil Nurs. 2013;38(6):315-22.
8. Lightfoot CJ, Wilkinson TJ, Song Y, Burton JO, Smith AC. Perceptions of exercise benefits and barriers: the influence on physical activity behaviour in individuals undergoing haemodialysis and peritoneal dialysis. J Nephrol. 2021;34(6):1961-71.
9. Rosa CS, Bueno DR, Souza GD, Gobbo LA, Freitas IF Jr, Sakkas GK, et al. Factors associated with leisure-time physical activity among patients undergoing hemodialysis. BMC Nephrol. 2015;16(1):192.
10. Clarke AL, Young HM, Hull KL, Hudson N, Burton JO, Smith AC. Motivations and barriers to exercise in chronic kidney disease: a qualitative study. Nephrol Dial Transplant. 2015;30(11):1885-92.
11. Kendrick J, Ritchie M, Andrews E. Exercise in Individuals With CKD: a focus group study exploring patient attitudes, motivations, and barriers to exercise. Kidney Med. 2019;1(3):131-8.
12. Cavill NA, Foster CEM. Enablers and barriers to older people's participation in strength and balance activities: a review of reviews. J Frailty Sarcopenia Falls. 2018;3(2):105-13.

13. Yoshioka M, Kosaki K, Matsui M, Takahashi K, Shibata A, Oka K, et al. Physical activity, sedentary behavior, and skeletal muscle strength in patients with chronic kidney disease: an isotemporal substitution approach. Phys Ther. 2021;101(7):pzab101.

14. Leal VO, Mafra D, Fouque D, Anjos LA. Use of handgrip strength in the assessment of the muscle function of chronic kidney disease patients on dialysis: a systematic review. Nephrol Dial Transplant. 2011;26(4):1354-60.

15. Bohannon RW, Wang YC, Yen SC, Grogan KA. Handgrip strength: a comparison of values obtained from the NHANES and NIH toolbox studies. Am J Occup Ther. 2019;73(2):7302205080p1-9.

16. Cheng Y, Liu M, Liu Y, Xu H, Chen X, Zheng H, et al. Chronic kidney disease: prevalence and association with handgrip strength in a cross-sectional study. BMC Nephrol. 2021;22(1):246.

17. Stevens KI, Graham-Brown M, Lees JS. Let's get physical: considering and overcoming the barriers to physical activity in CKD. Nephrol Dial Transplan. 2023;38(6):1405-7.

18. Fiaccadori E, Sabatino A, Schito F, Angella F, Malagoli M, Tucci M, et al. Barriers to physical activity in chronic hemodialysis patients: a single-center pilot study in an Italian dialysis facility. Kidney Blood Press Res. 2014;39(2-3):169-75.

19. Yurtçiçek S, Hotun Şahin N, Miral M. The study of the validity and reliability of the Turkish version of physical activity barriers questionnaire. J Acad Soc Sci. 2018;6(71):396-404.

20. Ibrahim S, Karim NA, Oon NL, Ngah WZ. Perceived physical activity barriers related to body weight status and sociodemographic factors among Malaysian men in Klang Valley. BMC Public Health. 2013;13(1):275.

21. Pinto AP, Ramos CI, Meireles MS, Kamimura MA, Cuppari L. Impact of hemodialysis session on handgrip strength. J Bras Nefrol. 2015;37(4):451-7.

22. Richardson JTE. Eta squared and partial eta squared as measures of effect size in educational research. Educ Res Rev. 2011;6(2):135-47.

23. Schober P, Boer C, Schwarte LA. Correlation coefficients: appropriate use and interpretation. Anesth Analg. 2018;126(5):1763-8.

24. Debnath S, Rueda R, Bansal S, Kasinath BS, Sharma K, Lorenzo C. Fatigue characteristics on dialysis and non-dialysis days in patients with chronic kidney failure on maintenance hemodialysis. BMC Nephrol. 2021;22(1):112.

25. Moorman D, Suri R, Hiremath S, Jegatheswaran J, Kumar T, Bugeja A, et al. Benefits and barriers to and desired outcomes with exercise in patients with ESKD. Clin J Am Soc Nephrol. 2019;14(2):268-76.

26. Ghafourifard M, Mehrizade B, Hassankhani H, Heidari M. Hemodialysis patients perceived exercise benefits and barriers: the association with health-related quality of life. BMC Nephrol. 2021;22(1):94.

27. Gerovasili V, Agaku IT, Vardavas CI, Filippidis FT. Levels of physical activity among adults 18-64 years old in 28 European countries. Prev Med. 2015;81:87-91.

28. Cai Lian T, Bonn G, Si Han Y, Chin Choo Y, Chee Piau W. Physical activity and its correlates among adults in Malaysia: a cross-sectional descriptive study. PLoS One. 2016;11(6):e0157730.

29. Kaur J, Kaur G, Ho BK, Yao WK, Salleh M, Lim KH. Predictors of physical inactivity among elderly malaysians: recommendations for policy planning. Asia Pac J Public Health. 2015;27(3):314-22.

30. Calogiuri G, Elliott LR. Why do people exercise in natural environments? Norwegian adults' motives for nature-, gym-, and sports-based exercise. Int J Environ Res Public Health. 2017;14(4):377.

31. Zelle DM, Klaassen G, van Adrichem E, Bakker SJ, Corpeleijn E, Navis G. Physical inactivity: a risk factor and target for intervention in renal care. Nat Rev Nephrol. 2017;13(3):152-68.

32. Villanego F, Naranjo J, Vigara LA, Cazorla JM, Montero ME, García T, et al. Impact of physical exercise in patients with chronic kidney disease: systematic review and meta-analysis. Nefrol (Engl Ed). 2020;40(3):237-52.

33. Farragher JF, Polatajko HJ, McEwen S, Jassal SV. A proof-of-concept investigation of an energy management education program to improve fatigue and life participation in adults on chronic dialysis. Can J Kidney Health Dis. 2020;7:2054358120916297.

34. Regolisti G, Maggiore U, Sabatino A, Gandolfini I, Pioli S, Torino C, et al. Interaction of healthcare staff's attitude with barriers to physical activity in hemodialysis patients: a quantitative assessment. PLoS ONE. 2018;13(4):e0196313.

35. Baillot A, Chenail S, Barros Polita N, Simoneau M, Libourel M, Nazon E, et al. Physical activity motives, barriers, and preferences in people with obesity: a systematic review. PLoS One. 2021;16(6):e0253114.

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TÜRK FİZYOTERAPİ VE REHABİLİTASYON DERGİSİ

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TÜRKİYE'DE FİZYOTERAPİ VE REHABİLİTASYON ALANINDA, ÖĞRENCİ, AKADEMİSYEN VE KLİNİSYEN BAKIŞ AÇISIYLA KANITA DAYALI UYGULAMANIN YERİ: PİLOT ÇALIŞMA

ÖZ

Amaç: Kanıta dayalı uygulama (KDU), yüksek kaliteli klinik araştırmalara ve uygulamalara dayanan bir yöntemdir. Dünya Fizyoterapi Konfederasyonu'na göre KDU eğitimi fizyoterapi uygulama önerilerinin başında gelmelidir. Çalışmamızın amacı Türkiye'de fizyoterapi ve rehabilitasyon alanında, öğrenci, akademisyen ve klinisyen bakış açısıyla KDU'nun yerini ve önündeki engelleri araştırmaktır.

Yöntem: Çalışma pilot çalışma olarak planlanmıştır. Çalışma süresince ulaşılabilecek bütün fizyoterapi ve rehabilitasyon alanında olan öğrenci, akademisyen ve klinisyenler ile çalışma gerçekleştirilmiştir. Değerlendirmede 28 sorudan oluşan "KDU Ölçeği" ve çalışmacılar tarafından hazırlanan KDU konusundaki görüşler, bilgi seviyesi, önündeki engellerin sorgulandığı bir form kullanılmıştır. Çalışma verileri web tabanlı bir form oluşturularak toplanmıştır.

Bulgular: Çalışmamız 44 öğrenci, 22 akademisyen ve 31 klinisyen olmak üzere toplam 97 kişi ile gerçekleştirilmiştir. KDU'yu engelleyen faktörler cevaplarında "Order (tedavide hekim talimatı) almak" öğrencilerde %51,06, akademisyenlerde ve %31,57 klinisyenlerde %33,33 oranla ilk engel olarak belirtilmiştir. KDU ölçeği toplam puanları üç grup arasında karşılaştırıldığında istatistiksel olarak anlamlı farklar olduğu tespit edilmiştir (p=0,000).

Sonuç: Çalışmamızın sonuçlarına bakıldığında farklı alanlarda bulunan fizyoterapistlerin KDU bilgi ve tutumlarının farklılıklar gösterdiği fakat ortak olarak Türkiye'de fizyoterapi ve rehabilitasyon alanında, öğrencilerin, klinisyenlerin ve akademisyenlerin KDU zorlaştırıcılarının başında "Order almak" faktörünün olduğu görülmüştür.

Anahtar Kelimeler: Klinisyen, Kanıta dayalı uygulama, Fizik tedavi, Rehabilitasyon

THE ROLE OF EVIDENCE-BASED PRACTICE IN THE FIELD OF PHYSIOTHERAPY AND REHABILITATION IN TÜRKİYE FROM THE PERSPECTIVES OF STUDENTS, ACADEMICIANS, AND CLINICIANS: A PILOT STUDY

ABSTRACT

Purpose: Evidence-based practice (EBP) is a method based on high-quality clinical research and practice. According to the World Confederation for Physical Therapy, EBP training should be at the forefront of physiotherapy practice recommendations. The aim of our study is to investigate the place of EBP and the barrier to it in the field of physiotherapy and rehabilitation in Türkiye from the perspective of students, academicians and clinicians.

Methods: The study was planned as a pilot study. The study was carried out with all students, academicians and clinicians in the field of physiotherapy and rehabilitation that could be reached during the study. In the evaluation, the "EBP Scale" consisting of 28 questions and a form prepared by the researchers questioning the opinions, knowledge level and obstacles to EBP were used. The study data were collected by creating a web-based form.

Results: Our study was conducted with a total of 97 people, 44 students, 22 academicians and 31 clinicians. In the responses to the factors that prevent EBP, "Obtaining an order (doctor's instructions for treatment)" was stated as the first obstacle by 51.06% of students, 31.57% of academicians and 33.33% of clinicians. When the total EBP scale scores were compared between the three groups, statistically significant differences were found (p=0.000).

Conclusion: When the results of our study were examined, it was seen that the knowledge and attitudes of physiotherapists in different fields regarding EBP varied, but in common, the main factor that made EBP difficult for students, clinicians and academicians in the field of physiotherapy and rehabilitation in Türkiye was the "taking orders" factor.

Keywords: Clinicians, Evidence-based practice, Physical therapy, Rehabilitation

GİRİŞ

Kanıta dayalı uygulama (KDU), yüksek kaliteli klinik araştırmalara dayanan bir uygulama yöntemidir. Kanıtlar yüksek kalitede klinik araştırmalardan oluşabilirken, aynı zamanda düşük kaliteli araştırmalardan, uzman görüşlerinden veya klinik deneyimlerden de oluşabilir (1). KDU hareketi, bir İngiliz hekim olan Archie Cochrane'nin, 1970'li yıllarda sağlık bakım kararlarının sadece tıbbi görüşlere ya da deneyimlere değil, kanıta dayalı olması gerektiğine dikkat çekmesiyle başlamıştır (2). KDU'nun yaygınlaşmasının sebepleri arasında bakım maliyetini düşürmesi, kaliteli hasta bakımının verilmesi, uygulamaların güvenlik kültürü oluşturması, hastanın hastanede kalma süresini kısaltması, ihtiyaç duyulan uygulamalarda azalma sağlaması sayılabilir (3,4).

Dünya Fizyoterapi Konfederasyonu'na (WCPT) göre, fizyoterapi ve rehabilitasyonda KDU, ulaşılabilen en iyi kanıtın hastaya uygulanması şeklinde tanımlanır. WCPT fizyoterapistler için; KDU prensibine uyulması gerektiğini, etkisiz veya güvensiz olduğu kanıtlanmış teknikleri kullanmamasını, kanıtların klinik deneyimlerle bütünleştirilmesini, kültürel bağlam ve hasta tercihleri gibi faktörleri dikkate alınmasını, klinik uygulamaların eleştirel bakışla değerlendirebilmesini, kanıtlara ulaşabilmeyi, yaşam boyu öğrenme ilkesinin benimsenmesini, multidisipliner çalışmayı önermektedir (5). Türkiye'de Fizyoterapi ve Rehabilitasyon eğitiminin geliştirilmesine yönelik gereklilikler, Yüksek Öğretim Kurulu Fizyoterapi Rehabilitasyon Ulusal Çekirdek Eğitim Programı (2016) ile belirlenmektedir (6). Bu programda fizyoterapistin geliştirmiş olduğu hipotez doğrultusunda tanı, tedavi, bakım ve önleme ile ilişkili stratejileri hizmet alanın beklentilerine saygı duyarak ve KDU prensipleri çerçevesinde yapmasının gerekliliği belirtilmiştir (7).

KDU'nun başarılı olabilmesi için klinikle birleştirmek gereklidir bu da klinik becerilerin ve geçmiş tecrübelerin kullanılmasını gerektirir. Yapılan çalışmalarda fizyoterapi ve rehabilitasyon son sınıf öğrencileri klinik uygulamada acemi olduklarını stajyerlik dönemlerinde onlara süpervizörlük yapan klinisyenleri bilgi kaynağı olarak gördüklerini, kanıtları kendi başına aramaktansa deneyimli birine başvurmanın daha uygun ve etkili olduğunu belirtmişlerdir (8). Belçikalı fizyoterapistler arasında KDU'nun klinik çalışmalara uygulanmasındaki engeller araştırıldığında KDU'nun uygulanmasındaki önemli engeller arasında, fizyoterapistlerin hastaların tedavileri üzerinde karar verme yetkisinin ve otoritesinin olmaması, bilimsel kanıtların eksikliği, erişilebilirliği ve uygulanabilirliği, ekonomik parametreler, hastaların beklentileri ve motivasyon eksikliği görülmüştür (9). Fizyoterapistlerin kanıta dayalı bakım sağlama konusundaki görüşleri, engelleri ve kolaylaştırıcıları araştıran bir çalışmada, fizyoterapistlerin kanıta dayalı bakım sağlaması için iş yerlerinin yapısal desteği artırması, fizyoterapistlerin hasta beklentisi ile gerçek hasta beklentisi arasındaki farklılıkların araştırılması gerekliliği sonucuna varılmıştır (10). Suudi Arabistan'da fizyoterapistlerin KDU'ya ilişkin görüşlerine başvurulan kesitsel bir çalışmada, KDU kavramının anlaşılması ve uygulanması konusunda belirgin bir eksiklik olduğunu, fizyoterapistlerin çoğunluğunun KDU konusunda resmi bir eğitim almadıklarını bildirdikleri görülmüştür (11). Aynı çalışmada KDU ile ilgili kavramların lisans ve lisansüstü müfredata entegre edilmesi ve fizyoterapistlerin KDU konusunda bilgi ve yeterlilik kazanmasını teşvik edecek stratejilerin hayata geçirilmesi gerekliliği vurgulanmıştır (11). Fizyoterapistlerin KDU bilgilerine, tutumlarına, uygulamalarına odaklanan otuz iki çalışmanın dahil edildiği bir sistematik derlemede birçok fizyoterapistin KDU'ya karşı olumlu tutumunun olduğu, KDU önündeki engeller arasında zaman ve beceri eksikliği ve KDU'nun yanlış algılanması bilgisi yer almaktadır (12). KDU eğitimi, fizyoterapistlerin meslek hayatlarının birçok alanına uygulayabilecekleri, mesleki becerilerini geliştiren ve hızlı sonuç veren yöntemdir (13). Ön lisans, lisans ve lisansüstü fizyoterapi eğitim programlarının yanı sıra kişilerin yaşam boyu öğrenme sürecinde de yer almalıdır. KDU yaklaşımına dayalı öğrenme sürecinin öğrenci, öğretim elemanları, klinik uygulamadaki öğretici ve rehberler arasında algı ve tutumlarını belirlemek amacıyla daha kapsamlı araştırmaların yapılması önerilmektedir (3). Literatür incelendiğinde KDU'nun önemi görülmüş ve çeşitli ülkelerde çalışmalara rastlanmıştır. Türkiye'de de KDU'nun birçok disiplinde araştırıldığını ve çalışmaların öğrenci, klinisyen, akademisyen açısından farklılık gösterdiği görülmüştür (14-16). Bilgimiz dahilinde Türkiye'de fizyoterapi ve rehabilitasyon alanında KDU'nun öğrenci, akademisyen ve klinisyen bakış açısından inceleyen herhangi bir çalışma bulunmamaktadır. Bu nedenle bu çalışmanın amacı Türkiye'de fizyoterapi ve rehabilitasyon alanında, öğrenci, akademisyen ve klinisyen bakış açısıyla KDU'nun yerini ve önündeki engelleri araştırmaktır. Bu çalışma sayesinde Türkiye'de fizyoterapi ve rehabilitasyon alanında, öğrenci, akademisyen ve klinisyenlerin KDU hakkındaki görüşlerine başvurup farklı bakış açılarından değerlendirmeyi hedeflemiş bulunmaktayız. Çalışmamızın hipotezleri; fizyoterapi ve rehabilitasyon alanındaki öğrenciler, akademisyenler ve klinisyenlerin KDU konusundaki bilgi düzeyleri arasında anlamlı fark vardır, KDU'nun uygulanmasında karşılaşılan engeller, öğrenciler, akademisyenler ve klinisyenler arasında farklılık göstermektedir.

YÖNTEM

Çalışma pilot çalışma olarak planlanmıştır. Çalışma süresince ulaşılabilecek bütün fizyoterapi ve rehabilitasyon alanında olan öğrenci, akademisyen ve klinisyenler ile çalışma gerçekleştirilmiştir. Çalışma için Ankara Yıldırım Beyazıt Üniversitesi Sağlık Bilimleri Etik Kurulu'ndan onay alınmıştır

(tarih: 22.04.2024, karar no: 04-665). Çalışma verileri etik kurul izninden sonra 3 aylık bir sürede web tabanlı bir form oluşturularak Türkiye'nin farklı illerindeki fizyoterapi ve rehabilitasyon son sınıf öğrencilerine, fizyoterapi ve rehabilitasyon alanındaki akademisyenlere klinikte çalışan fizyoterapistlere gönderilmiştir. Çalışmada veriler "Kartopu Yöntemi" ile toplandığı ve pilot çalışma olarak görüldüğü için çalışmada örneklem büyüklüğü hesaplanmamıştır. Çalışmaya dahil edilme kriterleri; çalışmaya katılmayı kabul etmek ve onam vermek, Türkiye'de dört yıllık fizyoterapi ve rehabilitasyon eğitimi almış ya da alıyor ve son sınıf öğrencisi olmak, Türkiye'de çalışıyor olmak (akademisyen ve klinisyen için) olarak belirlendi. Dışlanma kriteri; çalışmaya katılmayı kabul etmemek ve onam vermemek, 2 yıllık fizyoterapi eğitimi almak ve Türkiye'de dört yıllık fizyoterapi ve rehabilitasyon alıyor ancak son sınıf öğrencisi olmamak olarak belirlendi. Dahil edilme kriterlerine uyan fizyoterapi ve rehabilitasyon son sınıf öğrencilerine, fizyoterapi ve rehabilitasyon alanındaki akademisyenlere klinikte çalışan fizyoterapistlere 28 sorudan oluşan "KDU Ölçeği" sorularını kendilerine göre cevaplamaları istenmiştir. Ölçeğin geçerlik ve güvenirlik çalışmasını Çay ve Daşbaş (17) yapılmıştır. Ölçekte kişinin KDU'ya karşı bakış açısına ilişkin 28 madde vardır ve her maddede 6'lı derecelendirme kullanılmaktadır. Gelecekte kullanım, tutum, bilgi, kişisel kullanım olarak 4 alt boyutu vardır Ölçekte yer alan 10, 11, 12, 13 ve 14. maddeler tersten puanlanmaktadır. Ölçekten alınan yüksek puanlar, bireylerin KDU düzeylerinin daha gelişmiş olduğunu göstermektedir. Ölçek kullanımına ilişkin gerekli izinler alınmıştır. Aynı zamanda kişilerden yaş, boy uzunluğu, vücut ağırlığı gibi demografik verileri istenmiştir. Aynı zamanda katılımcının çalışma alanı ile ilgili sorulara (nerde çalıştığı, beraber çalıştığı meslek grupları, süpervizörlük yapması, ders verme durumu, meslekteki çalışma süresi, klinik çalışma yapma durumu) da yer verilmiştir. Değerlendirme formunda KDU konusundaki görüşler, bilgi seviyesi, önündeki engeller sorgulanmıştır. Anketi uygulama süresi ortalama 10-15 dakika olarak belirlenmiştir.

Bireyler çalışmaya katılmayı kabul etmek istemeyeceği gibi, çalışmaya katıldıktan sonra da ölçekte dilediği soruda bırakıp ölçeği tamamlamama hakkına sahipti. Araştırmada tüm soruları eksiksiz yanıtlayan bireylerin verileri kullanılmıştır. Çalışmaya katılmayı kabul eden katılımcılara herhangi bir maddi ödeme yapılmamıştır. Çalışma için Ankara Yıldırım Beyazıt Üniversitesi Sağlık Bilimleri Etik Kurulu'ndan etik kurul izni alınmıştır (tarih: 22.04.2024, numara: 04-665). Etik kurul izninden sonra web tabanlı anket uygulaması ile veri toplama işlemi gerçekleşmiştir. Ardından verilerin istatistiksel analizi gerçekleştirilmiştir.

İstatistiksel Analiz

Verilerin analizinde Statistical Package for Social Sciences (SPSS) for Windows 22.0 (SPSS Inc, Chicago, IL, ABD) programı kullanılmıştır. Tanımlayıcı verilerin analizinde sayı, yüzde, ortalama ve standart sapma kullanılmıştır. Verilerin normal dağılımını belirlemek amacıyla basıklık ve çarpıklık değerlerine bakılmış (+1, -1) (18) ve normal dağılım durumları histogram üzerinden çan eğrisi, varyans katsayısı, Kurtosis-Skewness, Kolmogorov-Smirnov/ Shapiro-Wilk ve Detrended Plot değerlendirmeleri yapılarak belirlenmiştir. Normal dağılım göstermeyen verilerin değerlendirilmesinde Mann-Whitney U testi, Kruskal-Wallis varyans testi kullanılmıştır. Anlamlı çıkan sonuçlar için farkın kaynağını belirlemek amacıyla da post hoc test istatistiklerinden Bonferroni testi kullanılmıştır. Yapılan istatistiksel testlerde güven aralığı %95 ve anlamlılık seviyesi $p<0,05$ olarak alınmıştır.

BULGULAR

Çalışmamız 44 öğrenci, 31 klinisyen ve 22 akademisyen olmak üzere toplam 97 kişi ile gerçekleştirilmiştir. Çalışmaya katılan öğrenci, klinisyen ve akademisyenlerin yaş ortalamaları ve vücut kütle indeksi değerleri Tablo 1'de gösterilmiştir.

Elde edilen verilere göre öğrencilerin %38,6'sı KDU eğitimi aldığı, %91,4'ü bu eğitimi almadıklarını belirtmiştir. KDU'nun çalışma hayatında kullanımı sorgulandığında öğrencilerin %65,9'u kullanmadığını bildirirken, %38,6'sı KDU'yu kullandığını bildirmiştir. Öğrencilerin KDU kullanımında ilk başvurdukları yerin ders notları ve kitaplar %38,6 olduğu görülmüştür.

Tablo 1. Katılımcıların demografik ve fiziksel özellikleri

	Öğrenci (n=44)	Klinisyen (n=31)	Akademisyen (n=22)
Yaş (ort ± SS)	22,93±2,02	28,96±4,00	31,72±5,17
Boy (cm) (ort ± SS)	166,63±7,38	169,58±7,46	169,22±7,21
Vücut ağırlığı (kg) (ort ± SS)	66,09±13,96	67,77±13,43	71,95±16,54
VKİ	23,80±4,80	23,42±3,43	25,10±5,61
Kadın (n/%)	37/84,1	19/61,3	17/77,3
Erkek (n/%)	7/15,9	12/38,7	5/22,7

Ort ± SS: Ortalama ± Standart Sapma, VKİ: Vücut Kütle İndeksi, n: Kişi Sayısı.

Öğrencilerin %84,1'i kanıt piramidi bilmediklerini bildirmiştir. Kanıt değeri en yüksek çalışma sorusunu doğru bilme oranı öğrencilerde %40,9 yanlış bilme oranı %49,1 idi. Kanıt değeri en düşük çalışma sorgulandığında öğrencilerin doğru cevap oranı %13,6 iken yanlış cevap oranı %87,3 idi (Tablo 2).

Öğrencilerin KDU'yu engelleyen faktörler cevaplarından % 51,06'sı "order (tedavide hekim talimatı) almak" iken %21,27'si "KDU'ya dair bilgi eksikliği", %19,14'ü "zaman kısıtlılığı" ve %8,51'i "cihaz eksikliği" idi (Tablo 2).

Tablo 2. Öğrenci, akademisyen ve klinisyenlerin günlük ekran süresi ve KDU ile ilgili genel bilgileri

		Öğrenci		Akademisyen		Klinisyen	
		n	Yüzde	n	Yüzde	n	Yüzde
Bilgisayar kullanım süresi (saat)	0	17	38,6	2	9,1	8	25,8
	1-3	21	47,7	11	50	19	61,3
	3-5	4	9,1	6	27,3	4	12,9
	5-7	2	4,5	3	13,6	0	0
	Toplam	44	100,0	22	100,0	31	100,0
Telefon kullanım süresi (saat)	1-3	9	20,5	13	59,1	13	41,9
	3-5	21	47,7	5	22,7	13	41,9
	5-7	12	27,3	3	13,6	3	9,7
	7-10	2	4,5	1	4,5	2	6,5
	Toplam	44	100,0	22	100,0	31	100,0
KDU eğitim alma	Evet	17	38,6	16	72,7	18	58,1
	Hayır	27	61,4	6	27,3	12	38,7
	Toplam	44	100,0	22	100,0	30	96,8
KDU çalışma hayatında kullanım	Evet	15	34,1	19	86,4	18	58,1
	Hayır	29	65,9	3	13,6	13	41,9
	Toplam	44	100,0	22	100,0	31	100,0
KDU bilgi için ilk başvurulan yer	Çalışma arkadaşım	3	6,8	0	0	6	19,4
	Süpervizörüm	10	22,7	1	4,5	4	12,9
	Ders notlarım/kitaplar	17	38,6	1	4,5	2	6,5
	İnternet	5	11,4	2	9,1	5	16,1
	Literatürdeki çalışmalar	8	18,2	18	81,8	14	45,2
	Toplam	43	97,7	22	100,0	31	100,0
Kanıt piramidini bilme durumu	Evet	7	15,9	21	95,5	19	61,3
	Hayır	37	84,1	1	4,5	12	38,7
	Toplam	44	100,0	22	100,0	31	100,0
Kanıt değeri en yüksek çalışma	Doğru	18	40,9	20	90,9	21	67,7
	Yanlış	17	49,1	2	9,1	8	25,8
	Toplam	44	100	22	100	29	100
Kanıt değeri en düşük çalışma	Doğru	6	13,6	8	36,4	10	32,3
	Yanlış	38	87,4	14	64,6	19	61,2
	Toplam	44	100	22	100	29	100
KDU'yu engelleyen faktörler	Order (tedavide hekim talimatı) almak	24	51,06	12	12	16	33,33
	Zaman kısıtlılığı	9	19,14	7	7	15	31,25
	Cihaz eksikliği	4	8,51	12	12	7	14,58
	KDU'ya dair bilgi eksikliği	10	21,27	7	7	10	20,83
	Toplam	47	100	38	38	48	100

KDU: Kanıta Dayalı Uygulama, n: Kişi Sayısı.

KDU ölçeğine gelecekte kullanım, kişisel kullanım ve bilgi puanının KDU dersi alanlarda almayanlara göre daha yüksek olduğu bulunmuştur (p<0,05). Tutum puanının ise KDU dersi alanlar ile almayanlar arasında farklı olmadığı görülmüştür (p>0,05). KDU ölçeğinin toplam puanlarının eğitim alan öğrencilerde almayanlara göre daha yüksek olduğu belirlenmiştir (p<0,05) (Tablo 3).

Akademisyenlerden elde edilen verilere göre akademisyenlerin %72,7'si KDU eğitimi aldığını, %27,3'ü bu eğitimi almadıklarını belirtmiştir. KDU'nun çalışma hayatında kullanılma oranı akademisyenlerde %86,4 iken kullanılmama oranı %13,6 idi. KDU kullanımında ilk başvurulan yer akademisyenlerde %81,8 ile literatürdeki çalışmalar şeklindeydi (Tablo 2).

Akademisyenlerin %4,5'i kanıt piramidi bilmediklerini bildirdi. Kanıt piramidini bildiğini bildiren akademisyen oranı %95,5 idi. Kanıt değeri en yüksek çalışma sorusunu doğru bilme oranı ise %90,9 idi. Kanıt değeri en düşük çalışma sorgulandığında doğru cevap oranı %36,4 iken yanlış cevap oranı 64,6 idi (Tablo 2).

Akademisyenlerde KDU'yu engelleyen faktörler cevaplarından %31,57'si "order (tedavide hekim talimatı) almak" iken diğer %31,57'si "cihaz eksikliği"idi (Tablo 2).

KDU ölçeğinde tutum puanının KDU dersi alanlarda almayanlara göre daha yüksek olduğu bulunmuştur (p<0,05). Gelecekte kullanım, kişisel kullanım, bilgi ve ölçek toplam puanı KDU dersi alanlar ve almayanlarda farklı olmadığı görülmüştür (p>0,05) (Tablo 4).

Klinisyenlerden elde edilen verilerde klinisyenlerin %58,1'i KDU eğitimi aldığını belirtirken %38,7'si bu eğitimi almadıklarını belirtmiştir. KDU'nun çalışma hayatında kullanımı sorgulandığında klinisyenler %58,1'i kullandığını, %41,9'u kullanmadığını bildirmiştir. KDU kullanımında ilk başvurdukları yer klinisyenlerde, %45,2 ile literatürdeki çalışmalardı (Tablo 2).

Klinisyenlerin kanıt piramidi bilgileri sorgulandığında %61,3'ü kanıt piramidini bildiğini belirtti. Kanıt değeri en yüksek çalışma sorusunu doğru bilme oranı ise klinisyenlerde %67,7 idi. Yanlış cevap verme oranı ise %25,8 idi. Kanıt değeri en düşük çalışma sorusuna doğru cevap oranı %32,3 iken yanlış cevap oranı %61,2 idi (Tablo 2).

Klinisyenlerin KDU'yu engelleyen faktörlere cevaplarından %33,33'ü "order (tedavide hekim talimatı) almak" iken %31,25'i ise "zaman kısıtlılığı" idi. Ayrıca, %20,83'ü "KDU'ye dair bilgi eksikliği" ve %14,58'i "cihaz eksikliği" cevapları verilmiştir (Tablo 2).

KDU ölçeğine bütün alt boyutlarında ve toplam puanında KDU eğitimi alanlar ile almayanlar arasında farklı olmadığı görülmüştür (p>0,05) (Tablo 5).

KDU ölçeğinde eğitim almış kişilerde meslekler arasında tutum, bilgi puanı ve toplam puanda gruplar arası karşılaştırmalarda farkların anlamlı olduğu görülmüştür (p<0,05). İkili

Tablo 3. Öğrencilerde KDU alt boyut puanlarının karşılaştırılması

KDU alt boyut	Eğitim almış ort ± SS (n=17)	Eğitim almamış ort ± SS (n=27)	Z	p
KDUÖ gelecekte kullanım puanı	45,94±5,14	38,22±7,01	-3,52	**0,000***
KDU kişisel kullanım puanı	34,52±5,47	27,74±6,70	-3,38	**0,001***
KDUÖ tutum puanı	21,82±4,70	20,11±5,61	-0,90	0,365
KDU bilgi puanı	23,29±2,31	20,44±4,10	-2,51	**0,012***
KDU toplam puan	125,58±10,33	106,51±13,56	-4,01	**0,000***

*: Mann-Whitney U Test, p<0,05.KDU: Kanıta Dayalı Uygulama, n: Kişi Sayısı, ort ± SS: Ortalama ± Standart Sapma.

Tablo 4. Akademisyenlerde KDU alt boyut puanlarının karşılaştırılması

KDU alt boyut	Eğitim almış ort ± SS (n=16)	Eğitim almamış ort ± SS (n=12)	Z	p
KDUÖ gelecekte kullanım puanı	48,31±4,57	46±7,40	-0,483	0,629
KDU kişisel kullanım puanı	37±3,55	35,16±6,08	-0,521	0,602
KDUÖ tutum puanı	25,80±2,80	21,16±5,67	-2,26	**0,024***
KDU bilgi puanı	26,25±3,67	24,83±3,43	-1,08	0,277
KDU toplam puan	137,43±9,90	127,16±17,13	-129	0,196

*: Mann-Whitney U test, p<0,05. KDU: Kanıta Dayalı Uygulama, n: Kişi Sayısı, ort ± SS: Ortalama ± Standart Sapma.

karşılaştırma analizleri sonucunda tutum, bilgi puanı ve toplam puanda anlamlı farkın öğrenci ile akademisyenler arasındaki farktan ortaya çıktığı ve akademisyenlerin puanlarının öğrencilere göre anlamlı olarak daha fazla olduğu belirlenmiştir (p<0,05). Ayrıca bilgi puanında öğrenci klinisyen karşılaştırmasında da klinisyenlerin öğrencilerden anlamlı olarak bilgi puanlarının daha fazla olduğu ortaya çıkmıştır (p<0,05). Eğitim alanlarda gelecekte kullanım ve kişisel kullanım puanlarında ise mesleklere göre farklılık olmadığı saptanmıştır (p>0,05). Eğitim almayanlarda gelecekte kullanım, kişisel kullanım, bilgi puanı ve toplam puanda gruplar arasında anlamlı fark olduğu belirlenmiştir (p<0,05). Analiz sonucunda belirtilen puanlarda ortaya çıkan bu farkın öğrenci akademisyen grupları arasındaki farktan kaynaklandığı ve akademisyenlerin puanlarının öğrencilere göre anlamlı olarak daha yüksek olduğu görülmüştür (p<0,05). Bilgi puanında öğrenci ve klinisyen gruplarının karşılaştırmasında da klinikte çalışa fizyoterapistlerin öğrencilere göre bilgi puanlarının anlamlı olarak daha yüksek olduğu saptanmıştır (p<0,05). Eğitim almayanlarda Tutum puanı meslekler arasında farklı bulunmamıştır (p>0,05) (Tablo 6).

TARTIŞMA

Türkiye'de fizyoterapi ve rehabilitasyon alanında, öğrenci, akademisyen ve klinisyen bakış açısıyla KDU'nun yerini ve önündeki engelleri araştırmak amacıyla gerçekleştirdiğimiz çalışmamız sonucunda öğrencilerin büyük bir çoğunluğunun KDU'yu kullanmadığı, KDU kullanma engelinin order almak olduğu, KDU konusunda bilgi almak için ilk başvurduğu yerin ders notları ve kitaplar olduğu, KDU konusunda hem eğitim almış hem de eğitim almamış öğrencilerin KDU toplam puanının akademisyenlere göre daha düşük olduğu fakat klinisyenlerle ise benzer olduğu görülmüştür. Çalışmamıza

Tablo 5. Klinisyenlerde KDU alt boyut puanlarının karşılaştırılması

KDU alt boyut	Eğitim almış ort ± SS (n=18)	Eğitim almamış ort ± SS (n=12)	Z*	p
KDUÖ gelecekte kullanım puanı	46,88±6,47	43,91±9,26	-0,637	0,524
KDU kişisel kullanım puanı	31,77±7,55	30,66±6,13	-0,657	0,511
KDUÖ tutum puanı	23,38±5,05	20,41±5,68	-1,32	0,186
KDU bilgi puanı	26,50±3,48	25,50±4,48	-0,386	0,700
KDU toplam puan	128,55±16,87	120,50±21,45	-1,05	0,290

*: Mann-Whitney U test, KDU: Kanıta Dayalı Uygulama, n: Kişi Sayısı, Ort ± SS: Ortalama ± Standart Sapma.

Tablo 6. Meslekler arasında KDU puanlarının eğitim durumuna göre karşılaştırılması

	Öğrenci Ort ± SS	Klinisyen Ort ± SS	Akademisyen Ort ± SS	p
Gelecekte kullanım puanı				
Eğitim almış	45,94±5,14	46,88±6,47	48,31±4,57	0,415
Eğitim almamış	38,22±7,01[a]	43,91±9,26	46±7,40[a]	**0,029***
Kişisel kullanım puanı				
Eğitim almış	34,52±5,47	31,77±7,55	37±3,55	0,127
Eğitim almamış	27,74±6,70[a]	30,66±6,13	35,16±6,08[a]	**0,041***
Tutum puanı				
Eğitim almış	21,82±4,70[a]	23,38±5,05	25,80±2,80[a]	**0,024***
Eğitim almamış	20,11±5,61	20,41±5,68	21,16±5,67	0,885
Bilgi puanı				
Eğitim almış	23,29±2,31[a,b]	26,50±3,48[b]	26,25±3,67[a]	**0,003***
Eğitim almamış	20,44±4,10[b]	25,50±4,48[b]	24,83±3,43	**0,004***
Toplam puanı				
Eğitim almış	125,58±10,33[a]	128,55±16,87	137,43±9,90[a]	**0,013***
Eğitim almamış	106,51±13,56[a]	120,50±21,45	127,16±17,13[a]	**0,010***

*: Kruskal-Wallis Test, p<0,05, KDU: Kanıta Dayalı Uygulama, Ort ± SS: Ortalama ± Standart Sapma, [a]: Kruskal-Wallis testine göre öğrenci-akademisyen grubu arasında anlamlı fark var, [b]: Kruskal-Wallis testine göre öğrenci-klinisyen grubu arasında anlamlı fark var.

katılan klinisyenlerin eğitim düzeyleri farklılık gösterse de lisansüstü eğitim alan klinisyenler de bulunmaktadır. Ayrıca ülkemizde kliniklerde çalışan fizyoterapistlerin çeşitli eğitim ve seminerlere katılıyor olmalarının, akademisyenler ile klinisyenlerin KDU ölçeği puanlarında benzerlik oluşmasına yol açtığı düşünülmektedir.

Akademisyenlerin ve klinisyenlerin çoğunluğunun KDU'yu çalışma hayatında kullandığı belirlenmiştir. Çalışmamızın bulgularına benzer olarak, Latin Amerika'daki fizyoterapistlerin de KDU konusunda olumlu düşüncelere sahip olduğu ve çalışma hayatında kullandığı rapor edilmiştir (19). Ayrıca çalışmamızda akademisyenlerin KDU kullanma engelinin order almak ve cihaz eksikliği olduğu ve KDU konusunda bilgi almak için ilk başvurduğu yerin literatür olduğu görülmüştür. Benzer şekilde çalışmamızda klinisyenlerin çoğunluğunun KDU'yu çalışma hayatında kullandığı, KDU kullanma engelinin order almak olduğu ve KDU konusunda bilgi için ilk başvurduğu yerin literatür olduğu belirlenmiştir.

Literatürde sağlıkla ilgili çeşitli disiplinlerde öğrencilerin KDU konusundaki bilgi, tutum ve davranışları incelenmiştir (20-27). Yaptığımız çalışmada sağlık profesyonelleri içerisinde KDU kullanımının son derece önemli olduğu alanlardan fizyoterapi ve rehabilitasyon bölümü son sınıf öğrencilerinin KDU konusunda bilgi, tutum ve davranışları incelenmiştir. Bu konu ile ilgi tıp öğrencileriyle yapılan araştırmada çalışmamızla paralel olarak stajyerlerin büyük çoğunluğunun ileri düzeyde kanıta dayalı tıp becerileri edinmekle ilgilenmediğini belirtmişlerdir (25). Bu durumun sebepleri içerisinde birinci neden olarak veri tabanlarına ulaşım zorluğu ikinci neden olarak zaman kısıtlılığını belirtmişlerdir (25). Yaptığımız çalışmada öğrencilerin KDU zorlaştırıcıları arasında birinci sırada order almak varken ikinci sırada literatür ile paralel olarak bilgi eksikliği üçüncü sırada ise zaman kısıtlılığı belirtilmiştir. Fizyoterapi ve rehabilitasyon alanındaki engellerin bu şekilde sıralanmış olmasının nedeninin fizyoterapistlerin Türkiye'de fizik tedavi ve rehabilitasyon hekimlerinden order alması, hekimlerin böyle bir durumu olmamasından kaynaklandığını düşünmekteyiz. Order ile çalışmayan bir diğer meslek grubu olan diş hekimliği öğrencilerinin KDU ile ilgili bilgi, tutum, davranışlarını incelemeyi amaçlayan çalışmada, KDU ile ilgili bilgi ve uygulamanın yetersiz olduğunu KDU önündeki en büyük üç engelin bilgi kaynaklarının eksikliği, yetersiz zaman ve arama becerilerinin eksikliği olduğu bildirilmiştir (26). Order almak dışında bulunan diğer engellerin çalışmamızdaki öğrenci sonuçlarıyla paralellik gösterdiği ve diğer disiplinlerle ortak olduğu görülmektedir. Fizyoterapi öğrencilerinin KDU becerilerinin eğitimsel müdahalelerle geliştirilmesine ilişkin yapılan incelemede zaman kısıtlaması, bilimsel bilgi ve beceri eksikliği, farklı konulara eleştirel yaklaşamama ve tıbbi uygulamada özerkliğin eksikliği, fizyoterapi öğrencilerinin kendi algıladıkları en yüksek engeller olarak ortaya çıkmaktadır (28). Çalışmamızdaki KDU önündeki engellerden zaman, bilgi eksikliği, order ile tedavi uygulama (özerkliğin eksikliği) literatürle birebir bağdaşmaktadır (28). 2018 yılında fizyoterapi ve rehabilitasyon öğrencilerinin birinci sınıftan mezuniyete kadar KDU bilgisindeki değişimleri araştıran bir çalışmada KDU kurslarının öğrenciler üzerinde olumlu yönde değişikliğe yol açtığı belirtilmiştir (29). Çalışmamızda öğrencilerin KDU eğitimi almış olmasının literatüre benzer olarak KDU hakkında bilgi, tutum ve becerisini artırmada etkili olduğu görülmüştür. Norveç'te üçüncü sınıf fizyoterapi ve rehabilitasyon öğrencileriyle yapılan bir çalışmada eğitim içeriğinde KDU'ya yer verme düzeyi ile klinik uygulamalar sırasında KDU davranışı, becerileri ve engelleyici unsurları arasında bir ilişki olduğu gösterilmiştir (30). Eğitim içeriğinde KDU'ya yer verme düzeyi ile fizyoterapi öğrencilerinin KDU davranışları arasında, soru sorma, kanıt arama ve eleştirel olarak değerlendirme becerisi gibi unsurlarla ilişki bulunmuş aynı zamanda eğitim içeriği, zamanlaması, miktarı ve türü açısından müfredat boyunca KDU eğitim stratejileri keşfetmek için daha fazla araştırma yapılması gerektiği söylenmiştir (29). Çalışmamızda öğrencilerin KDU ölçeği toplam puanında ve alt parametrelerinde akademisyenlere ve klinisyenlere oranla daha düşük puanlar aldıkları görülmektedir. Bu durumun öğrencilerin meslek hayatlarına başlamadan önce sadece eğitim içeriğinde gördükleri KDU becerilerinin uygulamalarda deneyimlenememesinden kaynaklı olduğu düşünülmektedir. Literatüre paralel olarak ve çalışmamızın sonuçlarında da görüldüğü gibi fizyoterapi ve rehabilitasyon öğrencilerinin KDU becerilerini artırmak için eğitim içeriklerinde KDU'ya daha fazla yer verilmesi gerektiğini düşünmekteyiz.

Literatürde eğitim seviyesi yüksek fizyoterapistlerin KDU becerilerinin, veri tabanlarında arama yapma ve bir dizi KDU terminolojisini anlama olasılıklarının eğitim seviyesi daha düşük olan fizyoterapistlere göre daha yüksek olduğu rapor edilmiştir (31). Çalışmamızdaki akademisyenlerin KDU oranının yüksek olması bu sebeple literatürle uyumludur. Çalışmamız sonucunda tıpkı öğrenciler ve klinisyenlerde olduğu gibi akademisyenlerinde KDU zorlaştırıcılarındaki en önemli faktörden birinin order ile çalışmak olduğu bir diğer faktörün de cihaz eksikliği olduğu belirlenmiştir. Bu bağlamda ülkemizde order ile çalışmanın akademisyenlerin KDU zorlaştırıcı faktörü olarak yer alması literatürle uyumlu iken; cihaz eksikliğinin KDU zorlaştırıcı faktörü olarak karşımıza çıkmasının dikkat çekilmesi gereken bir durum olduğunu düşünmekteyiz.

Filipinli fizyoterapistlerde yapılan KDU eğitim programı sonrası KDU'ya yönelik bilgi, beceri, tutum ve davranışlarda iyileşmeler gözlemlenmiştir (32). Fizyoterapistler KDU davranışını engelleyen faktörler arasında hastaya müdahale eden ilk kişi olmayışını ve reçeteli bir programı değiştirmek için hekim onayı gerektiğini öne sürmüştür (33). Türkiye'deki

klinisyenleri değerlendirdiğimiz çalışmamızda KDU önündeki en büyük engelin Filipin örneğindeki gibi reçete ile yani order ile uygulama yapmak olduğu gözlemlenmiştir. Filipinli fizyoterapistlerin aksine çalışmamızda KDU eğitimi alan fizyoterapistler ile almayanlar arasında KDU bilgi, tutum ve davranış yönünden fark olmamasının KDU'nun önemli bir bileşeni olan kişinin klinik uzmanlığı alt başlığıyla ilişkili olmasından kaynaklandığını düşünmekteyiz. Bu düşüncemizi destekler şekilde Vietnam'daki fizyoterapistler klinik kararlar alırken kişisel deneyime, çalışma arkadaşlarına ve ders kitaplarına başvurduğunu belirtmiştir (33). Çalışmamızda ayrıca klinisyenlerin KDU için en çok literatürdeki çalışmalar ve çalışma arkadaşlarına başvurdukları belirlenmiştir. Klinisyenlerde literatüre başvurmanın ilk seçenek olmasının KDU ölçeğindeki eğitim alan ve almayan klinisyenler arasında fark olmamasının nedeni olduğunu düşünmekteyiz. Çalışmamızda klinisyenlerde KDU zorlaştırıcıları arasında en çok öne çıkan iki durumun order ile çalışmak ve zaman kısıtlılığı olduğu belirlenmiştir. KDU konusunda araştırma yapan Malezya, Birleşik Arap Emirlikleri, İtalya, Arjantin gibi birçok ülke en büyük engelin zaman kısıtlılığı olduğunu öne sürmüştür (34-38). Belçika gibi fizyoterapistlerin mesleki özerkliğinin olmadığı ülkelerde fizyoterapistler hekimlerin reçetelerine bağlıdır. Bir hekim fizyoterapiste, hastanın toplam fizyoterapi seansı sayısı, hastanın tıbbi bilgileri, fizyoterapistin haftada gerçekleştirmesi gereken tedavi sayısı ve verilmesi gereken tedavilerin tam içerikleri için bir reçete vermek zorundadır. Fizyoterapistin hekime danışmadan başka tedaviler gerçekleştirmesine veya hafta içerisindeki tedavi sıklığını değiştirmesine izin verilmemektedir (9). Çalışmamızın sonuçlarında Belçika örneğindeki gibi bizim ülkemizde de bu durumun ortaya çıktığı ve order ile çalışmanın klinisyenlerin KDU zorlaştırıcıları arasındaki en önemli faktör olduğu belirlenmiştir. Çalışmamızın limitasyonları KDU eğitimi alınan öğrenim düzeyinin (lisans, yüksek lisans, doktora) sorgulanmaması, KDU eğitim sürelerinin belirlenememesi, akademisyenlerde sadece ders sürelerinin sorgulanarak akademik danışmanlık, idari görevler gibi diğer iş yüklerinin değerlendirilmemesi ve yeterli düzeyde kişi sayısına ulaşılamamasıdır. Ayrıca her bir grup için cinsiyete göre dağılımlara bakılmadan analiz yapılması çalışmanın limitasyonları arasında sayılabilir. Ancak çalışmamız ile Türkiye'de öğrenci olan ve farklı alanlarda çalışan fizyoterapistlerin KDU yapmasındaki engeller ve KDU bakış açıları ortaya koyulmuştur. Bununla birlikte çalışmamız gelecekte yapılacak çalışmalara da kaynak teşkil etmektedir.

Literatürde fizyoterapi ve rehabilitasyon alanında öğrenci, klinisyen ve akademisyeni odak grup görüşmeleriyle değerlendiren bir çalışma sonucunda klinik ve akademik ortamın iş birliği yapması gerektiği bu sayede öğrencilerin yani gelecekteki klinisyen ve akademisyenlerin KDU kullanım oranının artacağı bildirilmiştir (8). Bu çalışmadaki gibi çalışmamızda da KDU'nun yeri ve zorlaştırıcı faktörlerinin öğrenci, klinisyen, akademisyen bakış açısını değerlendirmiş ve sonuçlarımızın literatür ile uyumlu olduğunu rapor etmiş bulunmaktayız.

SONUÇ

Sonuç olarak; Türkiye'de fizyoterapi ve rehabilitasyon alanında, öğrencilerin klinisyenlerin ve akademisyenlerin KDU zorlaştırıcılarının başında "order almak" faktörünün olduğu görülmüştür. Çalışmamızda öğrenci ve farklı alanlarda çalışan fizyoterapistler için order almanın KDU yapmayı engelleyen en önemli faktör olduğu net bir şekilde ortaya koyulmuştur. İleride bu konuyla ilgili daha büyük örneklem sayısıyla yapılacak çalışmalara ihtiyaç vardır.

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Hasta Onamı: Katılımcılardan web tabanlı bir form üzerinden onam alındı.

Destekleyen Kuruluş: Yoktur.

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Yazar Katkıları: Fikir/ Kavram- BA, ZA, FBB; Tasarım- BA, ZA, FBB; Denetleme/Danışmanlık- BA; Veri Toplama ve/veya işleme- ZA, FBB; Analiz ve/veya Yorumlama- ZA, FBB; Literatür taraması- ZA, FBB; Makale yazımı- BA, ZA, FBB; Eleştirel inceleme- BA.

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KAYNAKLAR

1. Herbert R, Jamtvedt G, Hagen KB, Elkins MR. Practical Evidence-Based Physiotherapy-E-Book. Elsevier Health Sciences; 2022.
2. Sackett DL. Evidence-based medicine. Seminars in perinatology: Elsevier; 1997.
3. Alcan V. A systematic review of the evidence-based implementation approach in physiotherapy and rehabilitation education. Sağlık Bilimlerinde Eğitim Dergisi. 2021;3(1):13-23.
4. Ceylan BK, Mete M. The concept of evidence-based nursing and evidencegeneration situations. Akşehir Meslek Yüksekokulu Sosyal Bilimler Dergisi. 2023(15):121-32.
5. World Confederation for Physical Therapy. Policy statement: Education [Internet]. London (UK): WCPT; 2019 [updated 2019, cited; 2024 Mar. 25] Available from: www.wcpt.org/policy/ps-education
6. World Confederation for Physical Therapy. Declaration of Principle: Evidence Based Practice [Internet]. London (UK): WCPT; 2019 [updated 2019, cited; 2024 Mar. 25] Available from: http://www.wcpt.org/node/29552

7. Kurulu Y. Fizyoterapi ve Rehabilitasyon Çekirdek Eğitim Programı FTRÇEP 2016. Ankara; 2016.
8. Olsen NR, Bradley P, Lomborg K, Nortvedt MW. Evidence based practice in clinical physiotherapy education: a qualitative interpretive description. BMC Med Educ. 2013;13:52.
9. Karin H, Filip S, Jo G, Bert A. Obstacles to the implementation of evidence-based physiotherapy in practice: a focus group-based study in Belgium (Flanders). Physiother Theory Pract. 2009;25(7):476-88.
10. Gleadhill C, Bolsewicz K, Davidson SRE, Kamper SJ, Tutty A, Robson E, et al. Physiotherapists' opinions, barriers, and enablers to providing evidence-based care: a mixed-methods study. BMC Health Serv Res. 2022;22(1):1382.
11. Alshehri MA, Alalawi A, Alhasan H, Stokes E. Physiotherapists' behaviour, attitudes, awareness, knowledge and barriers in relation to evidence-based practice implementation in Saudi Arabia: a cross-sectional study. Int J Evid Based Healthc. 2017;15(3):127-41.
12. Scurlock-Evans L, Upton P, Upton D. Evidence-based practice in physiotherapy: a systematic review of barriers, enablers and interventions. Physiotherapy. 2014;100(3):208-19.
13. Ayberk B, Özgül B, Bury J, Polat MG. Rotator cuff disorders: a survey of current physiotherapy practice in Turkiye. Turk J Physiother Rehabil. 2023;34(3):346-5.
14. Arslan Taş F, Akkoyun S, Muslu Karayağız G. Teaching evidence-based practice in nursing undergraduate and graduate programs in Turkey: a descriptive and cross-sectional study. Suleyman Demirel University Journal of Health Sciences. 2023;14(3):406-15.
15. Şahin AN, Acar M. Evidence-based practice in physiotherapy and rehabilitation. Baskent University Journal of Health Sciences. 2023;8(3):258-74.
16. Ulaş Karaahmetoğlu G, Kaçan Softa H. Investigation of nursing students' attitudes towards evidence-based nursing. Journal of Nursology. 2018;21(4):256-63.
17. Çay M, Daşbaş S. Kanıta dayalı uygulama ölçeğinin türkçeye uyarlanması: geçerlik ve güvenirlik çalışması. Toplum Ve Sosyal Hizmet. 2020;31(4):1514-46.
18. Morgan GA, Leech NL, Gloeckner GW, Barrett KC. SPSS for Introductory Statistics: Use and Interpretation, Second Edition (2nd ed.). Psychology Press. 2004.
19. Morales-Osorio MA, Ordoñez-Mora LT, Gutiérrez-Espinoza H, Araya-Quintanilla F, Bays-Moneo A, Ramírez-Vélez R. A survey of beliefs, attitudes, knowledge, and behaviors about evidence-based practice in physical therapists of Latin America: a cross-sectional study. Scientific Reports. 2024;14(1):27404.
20. Cardoso D, Couto F, Cardoso AF, Bobrowicz-Campos E, Santos L, Rodrigues R, et al. The effectiveness of an evidence-based practice (EBP) educational program on undergraduate nursing students' ebp knowledge and skills: a cluster randomized control trial. Int J Environ Res Public Health. 2021;18(1):293.
21. Awedew AF, Abera EG. Effectiveness of clinical integrated short course training of evidence based medicine for postgraduate medical specialty students in Ethiopia in 2022: a randomized control trial. PLoS One. 2023;18(1):e0277886.
22. Sancho I, Araolaza-Arrieta M, Villanueva-Ruiz I, Arbillaga-Etxarri A. Undergraduate research implementation in physiotherapy: a hands-on and real experience of a randomised controlled trial. BMC Med Educ. 2023;23(1):736.
23. Helgøy KV, Bonsaksen T, Røykenes K. Research-based education in undergraduate occupational therapy and physiotherapy education programmes: a scoping review. BMC Med Educ. 2022;22(1):358.
24. Chang ZF, Zhu C, Tao DY, Feng XP, Lu HX. [A survey on knowledge, attitude and practice related to evidence-based dentistry among dental students]. Shanghai Kou Qiang Yi Xue. 2017;26(2):204-8.
25. Aldugieman TZ, Alanezi RS, Alshammari WMG, Al-Shamary YWZ, Alqahtani MM, Alreshidi FS. Knowledge, attitude and perception toward evidence-based medicine among medical students in Saudi Arabia: Analytic cross-sectional study. J Family Med Prim Care. 2018;7(5):1026-31.
26. Aldajah S, Etoom M, Mysore SB, Alawneh A, Hadoush H, Al Jarrah M, et al. Evidence- based physiotherapy practice in Jordan: evaluation and identification of implementation factors. Physiother Theory Pract. 2023;39(12):2723-39.
27. ShahAli S, Kajbafvala M, Fetanat S, Karshenas F, Farshbaf M, Hegazy F, et al. Barriers and facilitators of evidence-based physiotherapy practice in Iran: a qualitative study. Musculoskeletal Care. 2023;21(4):1507-28.
28. Boshnjaku A, Arnadottir SA, Pallot A, Wagener M, Äijö M. Improving the evidence-based practice skills of entry-level physiotherapy students through educational interventions: a scoping review of literature. Int J Environ Res Public Health. 2023;20(16):6605.
29. McEvoy MP, Lewis LK, Luker J. Changes in physiotherapy students' knowledge and perceptions of EBP from first year to graduation: a mixed methods study. BMC Med Educ. 2018;18(1):109.
30. Olsen NR, Lygren H, Espehaug B, Nortvedt MW, Bradley P, Bjordal JM. Evidence-based practice exposure and physiotherapy students' behaviour during clinical placements: a survey. Physiother Res Int. 2014;19(4):238-47.
31. Eek F, Åsenlöf P, Stigmar K. Scientific approach and attitudes among clinically working physiotherapists in Sweden -a cross sectional survey. Arch Physiother. 2023;13(1):20.
32. Dizon JM, Grimmer-Somers K, Kumar S. Effectiveness of the tailored Evidence Based Practice training program for Filipino physical therapists: a randomized controlled trial. BMC Med Educ. 2014;14:147.
33. Dao HT, Pichaiyongwongdee S, Sullivan PE, Prasertsukdee S, Apinonkul B. Are physical therapists in Viet Nam ready to implement evidence-based practice? A survey. BMC Med Educ. 2018;18(1):317.
34. Yahui HC, Swaminathan N. Knowledge, attitudes, and barriers towards evidence-based practice among physiotherapists in Malaysia. Hong Kong Physiother J. 2017;37:10-8.
35. AlKetbi H, Hegazy F, Alnaqbi A, Shousha T. Evidence-based practice by physiotherapists in UAE: Investigating behavior, attitudes, awareness, knowledge and barriers. PLoS One. 2021;16(6):e0253215.
36. Castellini G, Corbetta D, Cecchetto S, Gianola S. Twenty-five years after the introduction of evidence-based medicine: knowledge, use, attitudes and barriers among physiotherapists in Italy - a cross-sectional study. BMJ Open. 2020;10(6):e037133.
37. Bevacqua N, Intelangelo L. Evidence-based practice in physiotherapy in Argentina: Barriers, perceptions and behaviors. Physiother Res Int. 2023;28(4):e2034.
38. Muntessu DLN, Ghassi HT, Buh FC, Nietho AW, Siewe JR, Mpatoutou MM. Assessment of Evidence-Based Practice (EBP) among physiotherapists in Cameroon: a cross-sectional survey. BMC Med Educ. 2024;24(1):332.

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PSYCHOMETRIC PROPERTIES OF THE TURKISH VERSION OF THE FACIT-DYSPNEA SCALE IN CANCER PATIENTS

ABSTRACT

Purpose: This study aimed to investigate the validity and reliability of the Turkish version of the Functional Assessment of Chronic Illness Therapy (FACIT)-Dyspnea Short Form in patients with cancer.

Methods: Fifty-two patients with cancer with complaint of dyspnea were included in the study. The validity and reliability of the FACIT-Dyspnea were evaluated via exploratory and confirmatory factor analyses, construct validity, internal consistency [Cronbach's alpha (α)], test-retest reliability [intraclass correlation coefficient, (ICC)], item-total correlations and split-half tests. For construct validity, correlations between FACIT-Dyspnea and Eastern Cooperative Oncology Group (ECOG), Performance Scale, Medical Research Council Dyspnea Scale, Cancer Dyspnea Scale and EuroQol 5-Dimension 3-Level questionnaire (EuroQoL-5D-3L) were examined.

Results: Factor Analyses results showed that the FACIT-Dyspnea has a unifactorial structure, with all items having high factor loadings. Significant correlations were found between the FACIT-Dyspnea and the ECOG, Medical Research Council Dyspnea Scale, Cancer Dyspnea Scale, and EuroQoL-5D-3L scores ($p< 0.05$). Cronbach's α of the FACIT-Dyspnea was found to be 0.973 and ICC was 0.85. Item-total correlations for items in the FACIT-Dyspnea ranged from 0.695 to 0.948. In the split-half test, the Cronbach's α for the first part of the FACIT-Dyspnea was 0.937 and for the second part was 0.955.

Conclusion: The Turkish version of FACIT-Dyspnea is valid and reliable in patients with cancer and is suitable for use by researchers and clinicians.

Keywords: Cancer, Dyspnea, Factor analysis, Health-related quality of life, Validity and reliability

KANSER HASTALARINDA FACIT-DISPNEA SKALASININ TÜRKÇE VERSİYONUNUN PSİKOMETRİK ÖZELLİKLERİ

ÖZ

Amaç: Bu çalışmada Kronik Hastalık Terapisinin Fonksiyonel Değerlendirmesi (FACIT)-Dispne Kısa Formu'nun Türkçe versiyonunun kanser hastalarında geçerliliğini ve güvenilirliğini araştırmak amaçlandı.

Yöntem: Çalışmaya dispne şikayeti olan elli iki kanser hastası dahil edildi. FACIT-Dispne'nin geçerliliği ve güvenilirliği, açıklayıcı ve doğrulayıcı faktör analizleri, yapı geçerliliği, iç tutarlılık [Cronbach alfa (α)], test-tekrar test güvenilirliği [sınıf içi korelasyon katsayısı (ICC)], madde-toplam korelasyonları ve split-half testleri ile değerlendirildi. Yapı geçerliliği için FACIT-Dispne ile Doğu Kooperatif Onkoloji Grubu (ECOG), Performans Ölçeği, Medikal Araştırma Konseyi Dispne Ölçeği, Kanser Dispne Ölçeği ve EuroQol 5-Boyutlu 3-Seviyeli anket (EuroQoL-5D-3L) arasındaki korelasyonlar incelendi.

Bulgular: Faktör Analizi sonuçları, FACIT-Dispne'nin tek faktörlü bir yapıya sahip olduğunu ve tüm maddelerin yüksek faktör yüklerine sahip olduğunu gösterdi. FACIT-Dispne ile ECOG, Medikal Araştırma Konseyi Dispne Ölçeği, Kanser Dispne Ölçeği ve EuroQoL-5D-3L arasında anlamlı korelasyonlar bulundu ($p<0,05$). FACIT-Dispne'nin Cronbach α'sı 0,973 ve ICC 0,85 olarak bulundu. FACIT-Dispne'deki maddelerin toplam madde korelasyonları 0,695 ile 0,948 arasında değişmekteydi. Split-half testinde, FACIT-Dispne'nin ilk bölümü için Cronbach α'sı 0,937 ve ikinci bölümü için 0,955 idi.

Sonuç: FACIT-Dispne'nin Türkçe versiyonu, kanser hastalarında geçerli ve güvenilirdir ve araştırmacılar ve klinisyenler tarafından kullanılmaya uygundur.

Anahtar Kelimeler: Kanser, Dispne, Faktör analizi, Sağlıkla ilgili yaşam kalitesi, Geçerlilik ve güvenilirlik

INTRODUCTION

Cancer is a major health problem worldwide and one of the leading causes of mortality and morbidity, caused by the uncontrolled growth and spread of cancer cells resulting from DNA damage due to genetic and environmental factors (1). Cancer treatment methods, including chemotherapy, radiotherapy, surgery, molecular targeted agents, hormone therapy, and immunotherapy, often lead to side effects that can be further intensified by the cancer itself. The most common side effects are pain, fatigue, anxiety-depression, toxicity, muscle weakness, nausea-vomiting and dyspnea. Dyspnea develops in patients with cancer as a result of many different pathologies. Conditions such as airway obstruction, pleural or pericardial effusion, or phrenic nerve compression due to tumor mass, as well as pneumonia, pulmonary embolism, reduced lung capacity, cardiac toxicity, anemia, fatigue, and cachexia related to cancer treatments may lead to dyspnea (2).

Dyspnea also known as breathlessness or air hunger, is a subjective experience of respiratory discomfort. Although gender, cancer types, presence of metastasis, cancer treatments, smoking history, environmental factors and comorbidities change the incidence of dyspnea, dyspnea develops in 10-90% of patients with cancer (3). Patients diagnosed with early-stage cancer report low rates of dyspnea, while up to 90% of patients with advanced-stage cancer experience dyspnea symptoms (4). Dyspnea, a significant clinical problem in all stages of cancer from diagnosis to the advanced stage, is particularly common in advanced stages, highlighting the critical importance of its assessment and management in these patients.

Dyspnea is an important determinant of functional exercise capacity, daily living activities, and quality of life in patients with cancer, and increased severity decreases survival rates (4). Monitoring dyspnea is crucial, as its frequency and severity tend to increase with cancer progression, making it an important prognostic indicator for various health parameters (4). However, cancer-related dyspnea is difficult to assess because it is a complex, multidimensional, and subjective sensation, and little attention is paid to treatment methods for dyspnea in patients with cancer. Dyspnea requires consideration of various aspects during evaluation, such as sensory-perceptual experience, emotional state, and its overall impact on daily living activities; therefore, the use of an assessment tool that measures these dimensions in patients with cancer is essential (5,6).

Although the Medical Research Council (MRC) scale and Cancer Dyspnea Scale (CDS) are frequently used in dyspnea researchs, these scales can not assess multiple aspects of a patient's dyspnea experience or sufficiently reflect factors related to functional limitations (4). The Functional Assessment of Chronic Illness Therapy (FACIT)-Dyspnea is a 33-item questionnaire to measure dyspnea and dyspnea-related limitations, and then a 10-item short form was developed (7). Different versions of the 10-item short form of the FACIT-Dyspnea have been shown to provide consistent, reliable, and valid assessment of dyspnea and dyspnea-related limitations (5,8). However, to our knowledge, no study has been conducted to validate the Turkish version of the FACIT-Dyspnea Short Form. Therefore, the present study aimed to examine the validity and reliability of the Turkish version of the FACIT-Dyspnea Short Form in patients with cancer.

METHOD

Study Design

This research is a cross-sectional and methodological study conducted to determine the validity and reliability of the Turkish version of the FACIT-Dyspnea Short Form in patients with cancer. The study was conducted between September 2021 and June 2022 at Dokuz Eylül University Hospital, Department of Medical Oncology. All participants gave written consent. The study was approved by the Dokuz Eylül University Non-invasive Research Ethics Committee (decision number: 2021/27-19, date: 06.10.20) and was carried out in accordance with the Declaration of Helsinki.

Demographic information was recorded, and the participants completed the questionnaires. Participants were asked to complete the Eastern Cooperative Oncology Group-Performance Status (ECOG-PS), FACIT-Dyspnea Short Form, CDS, MRC, and EuroQol 5-Dimension 3-Level questionnaire (EuroQoL-5D-3L) questionnaires. The researchers contacted the participants by phone 7-10 days after their appointments to repeat the FACIT-Dyspnea Short Form (retest).

Translation of the FACIT-Dyspnea

Although permission for the Turkish version of the questionnaire was obtained through facit.org, the translation protocol was still followed (9). Two bilingual (Turkish and English) native Turkish translators independently translated the FACIT-Dyspnea Short Form from English into Turkish, and the final version was synthesized by comparing the two translations. One of the translators was a health care professional while the other translator was not informed about the study. The English back translation of the FACIT-Dyspnea was prepared by two independent translators (who were fluent in Turkish, and native English speakers) who had not seen the original English version, and a single version was agreed upon after comparing the two versions. The pre-final version was approved by a bilingual committee of translators and health professionals (two physiotherapists and one medical doctor). Cognitive debriefing interviews were conducted with 10 patients with cancer using the pre-final version. To assess content validity, the

expert committee evaluated the relevance and congruence of each item in the FACIT-Dyspnea Short Form with the underlying construct. For each expert, the percentage of items deemed relevant was calculated, and the mean relevance percentage across all experts was computed, which was found to be 100%. The FACIT organization approved the Turkish translation as conceptually equivalent to the original Turkish version.

Participants

The population of the study consisted of volunteer individuals who were being treated as outpatients at the Dokuz Eylül University Hospital Department of Medical Oncology had a diagnosis of cancer and complaints of dyspnea, and met the inclusion criteria for the study. The sample size was calculated as a minimum of 50 people, at least 5 times the number of items (10). Volunteers who were over 18 years of age, diagnosed with stage I-IV cancer and receiving anti-cancer treatment, had dyspnea symptoms, and were literate in Turkish were included. Individuals who had difficulty understanding or completing the questionnaires were excluded from the study.

Data Collection

Socio-demographic and clinical information of the participants was evaluated.

Performance Status

Performance status was evaluated with the ECOG-PS (11). This scale is scored from 0 to 5, with each score indicates a functional status and the amount of assistance required, and is widely used to assess functional performance status in patients with cancer (12).

Dyspnea

FACIT-Dyspnea Short Form, developed by the FACIT organization, is a 10-item questionnaire used to assess dyspnea experienced by participants in activities performed in the last 7 days (7). Dyspnea during activities is graded on a 4-point Likert scale (0, no dyspnea; 1, mild dyspnea; 2, moderate dyspnea; 3, severe dyspnea; 4, I have not done this in the last 7 days). The participant who has not performed the specified activity in the last 7 days is questioned whether he/she cannot do this activity due to shortness of breath or for another reason. A high score indicates high dyspnea intensity or functional limitations (7).

CDS is a 12-item scale that evaluates dyspnea in patients with cancer and includes 3 subscales: effort, discomfort and anxiety. CDS items are scored ranging from 1 (not at all) to 5 (very much), and the total score is between 0 and 48. CDS subscale scores range from 0-20 for effort, 0-16 for anxiety, and 0-12 for discomfort. Increased scores indicate increased dyspnea severity (13).

MRC scale consists of 5-items regarding perceived breathlessness and is commonly used to measure the severity of dyspnea. Participants rated their level of dyspnea from 0 (no dyspnea) to 5 (very severe dyspnea, too breathless to leave home, or breathless when dressing or undressing) (14).

Health-Related Quality of Life

Health-related quality of life (HRQoL) was assessed with EuroQoL-5D-3L. The first part of the scale has five dimensions consisting of mobility, self-care, usual activities, pain/discomfort and anxiety/depression, and the items are rated with 3 options (no problem, some problem, extreme problem). In the second part, the participant was asked to rate their health status from 0 (worst health) to 100 (best health) on a 20-cm visual analog scale (15).

Statistical Analysis

Statistical analyses were conducted using the SPSS v.26 (Armonk, NY: IBM Corp.). Participants' clinical and socio-demographic characteristics were analyzed using descriptive statistics.

For the validity analysis of the FACIT-Dyspnea Scale-Short Form, exploratory factor analysis [principal axis factoring, direct oblimin (EFA)], confirmatory factor analysis (CFA), and construct validity were examined (16). Prior to EFA and CFA, the suitability of the dataset for factor analysis and the adequacy of the sample size were assessed using the Kaiser-Meyer-Olkin (KMO) and Bartlett's Sphericity test. For the dataset to be suitable for factor analysis, Bartlett's Sphericity Test must be significant ($p<0.05$). A KMO value of 0.60 or higher indicates that the sample size is adequate for factor analysis (17). CFA was conducted using maximum likelihood estimation with AMOS 23.0. goodness of fit indices were determined (18).

For construct validity, correlations between FACIT-Dyspnea Scale and ECOG-PS, MRC, CDS and EuroQoL-5D-3L scale were examined using the Pearson test. Correlation coefficients (rho, r) <0.40 were considered weak, 0.40-0.60 were considered moderate, and >0.60 were considered high correlation (19).

The reliability of the FACIT-Dyspnea Scale was measured by Cronbach's alpha (α), test-retest [intraclass correlation coefficient (ICC)], item-total correlations and split-half tests. Cronbach's α was calculated to assess the internal consistency of the FACIT-Dyspnea Scale items. Cronbach's α above 0.7 indicate adequate internal consistency (20). The interpretation of ICC's was as follows: low reliability (ICC <0.40), moderate reliability (ICC = 0.40-0.75), high reliability (ICC >0.75), and excellent reliability (ICC ≥0.90) (21). For item-total correlations, correlation coefficients greater than 0.3 were determined as acceptable levels (20). Statistical significance was set at $p<0.05$.

RESULTS

Sixty-two outpatients with cancer at Dokuz Eylül University Hospital were assessed for eligibility based on the inclusion criteria. Five participants were excluded from the study due to the absence of dyspnea symptoms, three were excluded for not completing the questionnaires, and two were excluded for refusing to participate. Consequently, 52 patients with cancer with complaint of dyspnea were included in the study (Figure 1).

The mean age of the participants was 60.80±11.43 years, and 17 were female (32.69%) and 35 were male (67.31%). All of the participants in the current study had stage 4 cancer (100%). Most of the participants had lung cancer (51.92%). It was determined that the participants experienced moderate to severe dyspnea, while their performance status was found to be at a moderate level. Table 1 shows the characteristics of the participants.

Validity

Factor Analysis

EFA and CFA was conducted to determine the underlying dimensions of the FACIT-Dyspnea Scale-Short Form and to enhance the validity of the questionnaire by understanding the factor structure. The EFA and CFA results of the FACIT-Dyspnea Scale are shown in Table 2. In the FACIT-Dyspnea Scale, a single factor with an eigenvalue greater than one was identified, with an eigenvalue of 8.14, accounting for 81.44% of the explained variance. In the rotated factor matrix of the FACIT-Dyspnea Scale, the lowest factor loading was 0.770, while the highest was 0.955. It was determined that the FACIT-Dyspnea Scale has a unifactorial structure, all items had high factor loadings, with none having a factor loading below 0.30, indicating that it would not be appropriate to remove any items from the scale.

In the Path Diagram of the CFA, the factor loadings of the FACIT-Dyspnea Short Form items were significant and the standardized regression coefficients ranged between 0.60 and

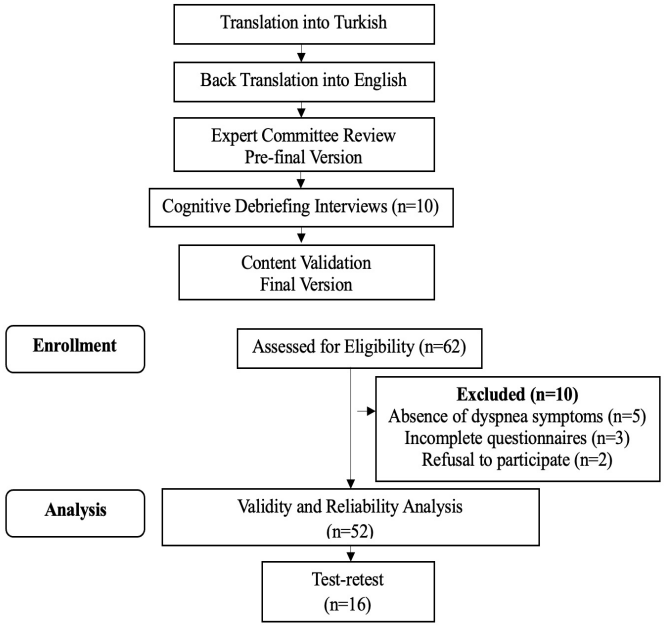

Figure 1. Flow diagram of the study.

Table 1. Characteristics of participants (n=52)

Variable	Mean ± SD n (%)
Age, years	60.80±11.43
Weight, kg	69.82±16.60
Height, m	1.70±0.09
BMI, kg/m^2	24.40±6.52
ECOG-PS	3.19±0.59
FACIT Dyspnea Scale-Short Form	23.58±9.18
CDS	25.71±11.55
CDS - effort	11.79±5.03
CDS - discomfort	7.17±4.58
CDS - anxiety	6.75±2.94
MRC	4.15±1.17
EuroQoL-5D-3L	0.07±0.37
EuroQoL-5D-3L (VAS)	44.13±23.57
Gender: Female/male	17 (32.69)/35 (67.31)
Age group: ≤59/60-69/≥70	22 (42.31)/19 (36.54) / 11 (21.15)
Marital status: Married/single	38 (73.08)/14 (26.92)
Education status: Primary school/ high school/university or above	32 (61.95)/13 (25.00)/7 (13.45)
Smoking: Current smoker/non-smoker/past smoker	2 (3.85)/18 (34.62)/32 (61.54)
Cancer type	
Lung	27 (51.92)
Colorectal	5 (9.62)
Breast	4 (7.69)
Kidney	3 (5.77)
Prostate	2 (3.85)
Stomach	2 (3.85)
Pancreas	2 (3.85)
Other	7 (13.46)
Chemotherapy: Yes/no	40 (76.92)/12 (23.08)
Radiotherapy: Yes/no	18 (34.62)/34 (65.38)
Hormone: Yes/no	2 (3.85)/50 (96.15)
Surgery: Yes/no	8 (15.38)/44 (84.62)

SD: Standard Deviation, n: Number; %: Percentage, kg: Kilogram, m: Meter; BMI: Body Mass Index, FACIT: Functional Assessment of Chronic Illness Therapy, VAS: Visual Analog Scale, CDS: The Cancer Dyspnea Scale, MRC: The Medical Research Council.

0.99 (Figure 2). In the CFA, the Goodness of Fit Index (GFI) χ^2/df was found to be 3.066, indicating that the FACIT-Dyspnea Scale has an acceptable fit, as this value falls within the range of 3.0 to 5.0. It was determined that the Normed Fit Index (NFI), comparative fit index (CFI) and GFI values of the FACIT-Dyspnea scale were acceptable, but the Root Mean Square Error of Approximation (RMSEA) values showed low fit.

Construct Validity

For construct validity, correlations between FACIT-Dyspnea Scale and ECOG-PS, MRC, CDS, EuroQoL-5D-3L scale were examined (Table 3). Statistically significant positive correlations were found between FACIT-Dyspnea Scale and ECOG-PS, MRC and CDS ($p<0.05$). Statistically significant negative correlations were found between FACIT-Dyspnea Scale and EuroQoL-5D-3L scale scores ($p<0.05$).

Reliability

Table 4 shows the results of Cronbach's α, test-retest and Split-Half tests conducted for the reliability of the FACIT-Dyspnea Scale. The Cronbach's α for FACIT-Dyspnea Scale was 0.973, which indicates that the FACIT-Dyspnea Scale has very high internal consistency. In addition, item-total correlations were examined for scale homogeneity. Item-total correlations for items in the FACIT-Dyspnea Scale ranged from 0.695 to 0.948. In the test-retest analysis conducted on 16 patients with cancer, the Turkish version of the FACIT-Dyspnea Scale showed high to excellent reproducibility in the test-retest analysis [ICC=0.85 (0.74-0.91)]. In the split-half test, the Cronbach's α of the first part of the FACIT-Dyspnea Scale was found to be 0.937 and the second part was found to be 0.955. The correlation coefficient between the two parts of the FACIT-Dyspnea Scale was 0.965, the spearman-brown coefficient was 0.982, and the guttman split-half coefficient was 0.979.

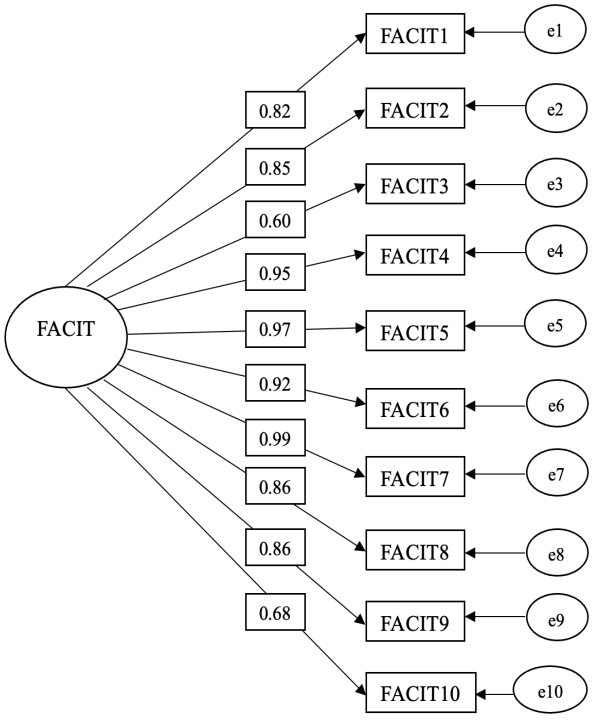

Figure 2. Path diagram of the confirmatory factor analysis
FACIT: Functional Assessment of Chronic Illness Therapy.

Table 2. Factor analysis of FACIT-Dyspnea Short Form

FACIT-Dyspnea Short Form items	Factor loadings	Eigenvalue	Variance explained
Q1	0.893	8.14	81.44
Q2	0.929	0.82	
Q3	0.742	0.43	
Q4	0.921	0.26	
Q5	0.955	0.19	
Q6	0.955	0.07	
Q7	0.955	0.06	
Q8	0.934	0.03	
Q9	0.940	0.00	
Q10	0.770	0.00	
Goodness of fit indices	**Values**	**Threshold values**	**Results**
χ^2/df	3.066	<5.00	Acceptable fit
NFI	0.938	>0.80	Acceptable fit
CFI	0.957	>0.90	Acceptable fit
GFI	0.902	>0.90	Acceptable fit
RMSEA	0.151	<0.08	Low fit

FACIT: Functional Assessment of Chronic Illness Therapy, χ^2/df: Chi-Square / Degrees of Freedom, NFI: Normed Fit Index, CFI: Comparative Fit Index, GFI: Goodness of Fit Index, RMSEA: Root Mean Square Error of Approximation.

Table 3. Construct validity of the FACIT-Dyspnea Short Form

	FACIT Dyspnea Scale-Short Form	
	r	p
ECOG-PS	0.274	**0.049***$^{\phi}$
MRC	0.808	**<0.001***$^{\phi}$
CDS - effort	0.738	**<0.001***$^{\phi}$
CDS - discomfort	0.721	**<0.001***$^{\phi}$
CDS - anxiety	0.656	**<0.001***$^{\phi}$
CDS	0.760	**<0.001***$^{\phi}$
EuroQoL-5D-3L	-0.459	**0.001***$^{\phi}$
EuroQoL-5D-3L (VAS)	-0.461	**0.001***$^{\phi}$

FACIT: The Functional Assessment of Chronic Illness Therapy, MRC: The Medical Research Council Dyspnea Scale, CDS: The Cancer Dyspnea Scale, VAS: Visual Analog Scale.
*: $p<0.05$, $^{\phi}$: Pearson Correlation Analysis.

Table 4. Cronbach's alpha and split-half test results of FACIT-Dyspnea Short Form			
Test (mean ± SD)	**Re-test (mean ± SD)**	**p**	**ICC**
28.69±2.89	28.63±3.05	0.564	0.85 (0.74-0.91)
Part	**Cronbach's alpha**		**Number of items**
Part 1	0.937		5
Part 2	0.955		5
FACIT-Dyspnea Scale	0.973		10
FACIT: Functional Assessment of Chronic Illness Therapy, SD: Standard Deviation, ICC: Intraclass Correlation Coefficients.			

DISCUSSION

Dyspnea is a respiratory discomfort experience that frequently develops in patients with cancer. The complex and multidimensional nature of dyspnea makes evaluation challenging. This study aimed to examine the validity and reliability of the Turkish version of the FACIT-Dyspnea Short Form in patients with cancer. The Turkish version of the FACIT-Dyspnea Short Form has demonstrated high reliability and validity, establishing it as an effective tool for assessing dyspnea in patients with cancer.

Psychometric studies on the FACIT-Dyspnea Form have been conducted in COPD and systemic sclerosis (7,8,22-24), with only one study examining its psychometric properties in patients with cancer (5). Ku et al. (5) examined the validation of the Korean version of the FACIT-Dyspnea Scale, reporting that 38.03% of the study population consisted of patients with breast cancer. However, they did not share information on the participants' cancer stages or the severity of dyspnea. In the current study, all participants had advanced cancer and 51.92% of the participants had lung cancer. The present study found that participants experienced moderate to severe levels of dyspnea.

In the EFA results, it was determined that the factor loadings of the items of the FACIT-Dyspnea Scale ranged from 0.770-0.955, and all items had high factor loadings. In the Turkish FACIT-Dyspnea Scale, the eigenvalue of the first factor was greater than one, the remaining factors were less than 1.0, and the first factor accounted for approximately 81.44% of the total variance. Similar to the current study, Choi et al. (7) reported the presence of a dominant first factor in the factor analysis performed to reduce the 33-item FACIT-Dyspnea questionnaire to 10 items, accounting for approximately 78% of the total variance.

In the CFA results, it was observed that the Turkish version of the FACIT-Dyspnea scale had acceptable fit indices for χ^2/df, NFI, CFI, and GFI except RMSEA. Similar to this study, Choi et al. (7) reported that the RMSEA was 0.152 in the CFA results. Although not all fit index values were statistically significant, it was suggested that the model fit could still be adequate. Additionally, since RMSEA is influenced by sample size, it may be disregarded in models with a small sample size (<250) (25,26). Based on this situation, the CFA indicates an acceptable fit to a unifactorial model. Consistent with the present study, Choi et al. (7), reported that the FACIT-Dyspnea Scale has a unifactorial structure, whereas Ku et al. (5) found that the Korean version of the FACIT-Dyspnea Scale exhibits a bifactorial structure.

Since dyspnea is influenced by physiological, psychological, social, and environmental factors, dyspnea questionnaires should be designed to comprise multidimensional assessments. In the current study MRC, CDS, ECOG-PS, EuroQoL-5D-3L and FACIT-Dyspnea Scale were significantly correlated. Numerous studies have reported the correlation between the MRC and the FACIT-Dyspnea Scale (5,7,22-24). This suggests that the dyspnea scales of each instrument can be used interchangeably in the measurement of dyspnea. The CDS is specifically designed for individuals with cancer and measures the psychometric properties of dyspnea. The MRC measures the difficulty experienced in daily functioning due to dyspnea. The FACIT-Dyspnea Short Form correlated highly with both scales, highlighting its ability to capture the multidimensional aspects of dyspnea experienced by patients with cancer and assess dyspnea severity and impact on daily living.

Performance status plays a vital role in both the functional level and prognosis of patients with cancer, as well as in determining the appropriate treatment plan. Ku et al. (5) reported a significant correlation between the ECOG-PS and the FACIT-Dyspnea scale in a Korean validation study. Damani et al. (27) found a significant correlation between the ECOG-PS and dyspnea severity in their study examining the effect of dyspnea prevalence and severity on HRQOL in patients with advanced cancer, and concluded that dyspnea severity was higher in individuals with worsening ECOG-PS scores. In line with the existing literature, the current study found that the presence and severity of dyspnea had a negative impact on performance status.

HRQoL is a measure of perceived physical and mental health (28). EuroQoL-5D-3L provides insights into both the physical and emotional parameters of HRQoL. Similar to previous studies (5,8,22,23), this research has confirmed a significant

correlation between dyspnea and both physical and emotional functioning. It has been noted that dyspnea negatively impacts physical and emotional well-being. The correlations of the FACIT-dyspnea questionnaire with dyspnea questionnaires, performance measures, and HRQoL assessments indicate that the FACIT-dyspnea questionnaire effectively measures different aspects of dyspnea, making it a suitable evaluation tool for assessing dyspnea in patients with cancer.

Reliability analysis was conducted using Cronbach's α, test-retest, and split-half methods. The Cronbach's α for the Turkish version of the FACIT-Dyspnea Scale was found to be 0.973, indicating excellent internal consistency among the items. In other validation studies, the FACIT-Dyspnea Scale Cronbach's α ranged from 0.90 to 0.949 (5,7,22,23). In the original version of the FACIT-Dyspnea Scale, item-total correlation coefficients ranged from 0.64 to 0.87 (7). Similar to this study, acceptable item-total correlations were observed among the items in the Turkish version of the FACIT-Dyspnea Scale. The Turkish version of the FACIT-Dyspnea Scale demonstrated high reability in the test-retest analysis (ICC=0.85) (0.74-0.91) Validation studies conducted on the original, Swedish and Korean versions of the FACIT-Dyspnea Scale reported ICCs ranging from 0.78 to 0.92, indicating acceptable retest reliability (5,7,22).

Limitations

The present study has some limitations. First, the current study included patients with various types of cancer. Focusing on a single type of cancer could have highlighted the effects of dyspnea in that specific cancer and demonstrated the efficacy of the FACIT-Dyspnea Scale. Second, due to the limited sample size, the discriminative ability of the FACIT-Dyspnea Scale could not be assessed according to cancer stages. In addition, the heterogeneity of the patient group in terms of cancer stages is also considered a limitation of the study.

CONCLUSION

In conclusion, the Turkish version of the FACIT-Dyspnea scale is valid and reliable for assessing the dyspnea of Turkish patients with cancer. The availability of a valid and reliable Turkish version of the FACIT-Dyspnea scale will enable clinicians and researchers to conduct a comprehensive assessment of dyspnea in patients with cancer. The use of the Turkish FACIT-Dyspnea scale in clinical practice and research will allow the monitoring of dyspnea in patients with cancer throughout their treatment and disease processes, providing feedback to healthcare professionals.

Ethics: The study was approved by the Dokuz Eylül University Non-invasive Research Ethics Committee (decision number: 2021/27-19, date: 06.10.20).

Informed Consent: All participants gave written consent.

Sources of Support: None.

Conflict of Interest: The authors declare that there is no conflict of interest.

Author Contributions: Concept- MT, DK; Design- MT, DK; Supervision- DK, TY; Data Collection and/or Processing- MT, DK, EE, EÇY; Analysis and/or Interpretation- MT, EE, TY; Literature Search- MT, Writing Manuscript- EE; Critical Review- MT, DK, EÇY, TY.

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REFERENCES

1. Siegel RL, Miller KD, Wagle NS, Jemal A. Cancer statistics, 2023. CA Cancer J Clin. 2023;73:17-48.
2. Hui D, Bohlke K, Bao T, Campbell TC, Coyne PJ, Currow DC, et al. Management of dyspnea in advanced cancer: ASCO guideline. J Clin Oncol. 2021;39:1389-411.
3. Ekström M, Johnson MJ, Schiöler L, Kaasa S, Hjermstad MJ, Currow DC. Who experiences higher and increasing breathlessness in advanced cancer? The longitudinal EPCCS Study. Support Care Cancer. 2016;24(9):3803-11.
4. Shin J, Kober K, Wong ML, Yates P, Miaskowski C. Systematic review of the literature on the occurrence and characteristics of dyspnea in oncology patients. Crit Rev Oncol Hematol. 2023;181:103870.
5. Ku Bİ, Oh DW, Lee MJ, Kim SK. Reliability and validity of Korean version of FACIT-dyspnea 10 item short form in patients with cancer. Phys Ther Korea. 2020;27(2):111-7.
6. Dudgeon DJ, Kristjanson L, Sloan JA, Lertzman M, Clement K. Dyspnea in cancer patients: prevalence and associated factors. J Pain Symptom Manage. 2001;21:95-102.
7. Choi SW, Victorson DE, Yount S, Anton S, Cella D. Development of a conceptual framework and calibrated item banks to measure patient-reported dyspnea severity and related functional limitations. Value Health. 2011;14(2):291-306.
8. Hinchcliff ME, Beaumont JL, Carns MA, Podlusky S, Thavarajah K, Varga J, et al. Longitudinal evaluation of PROMIS-29 and FACIT-Dyspnea short forms in systemic sclerosis. J Rheumatol. 2015;42(1):64-72.
9. Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process of cross-cultural adaptation of self-report measures. Spine (Phila Pa 1976). 2000;25(24):3186-91.
10. Memon MA, Ting H, Cheah JH, Thurasamy R, Chuah F, Cham TH. Sample size for survey research: review and recommendations. Journal of Applied Structural Equation Modeling. 2020;4(2):i-xx
11. Api M, Purut YE, Akış S, Keleş E, Yasin C, Kabaca C, et al. EP1199 validation of Turkish version of eastern cooperative oncology group performance status (ECOG-PS) for gynecologic oncology patients. Int J Gynecol Cancer. 2019;29(Suppl 4):A617.
12. Neeman E, Gresham G, Ovasapians N, Hendifar A, Tuli R, Figlin R, et al. Comparing physician and nurse eastern cooperative oncology group performance status (ECOG-PS) ratings as predictors of clinical outcomes in patients with cancer. Oncologist. 2019;24(12):e1460-6.
13. Bitek DE, Tokem Y. Investigating the validity and reliability of cancer dyspnea scale in Turkish cancer patients. İzmir Katip Çelebi Üniversitesi Sağlık Bilimleri Fakültesi Dergisi. 2021;6(1):155-62.

14. Kara D, Yıldız H. Effectiveness and frequencies of dyspnea scales in evaluating symptom of dyspnea. Gümüşhane Üniversitesi Sağlık Bilimleri Dergisi. 2013;2(1):137-49.

15. Eser E, Dinç Horosan G, Cambaz Ulaş S, Özyurt B C. EURO-QoL (EQ-5D) İndeksinin Toplum Standartları ve Psikometrik Özellikleri: Manisa Kent Toplumu Örneklemi. 2 Sağlıkta Yaşam Kalitesi Kongresi. 2007:5-7.

16. Bandalos DL, Finney SJ. Factor Analysis: Exploratory and confirmatory. The Reviewer's Guide to Quantitative Methods in the Social Sciences: 2nd ed. 2018: p. 98-122.

17. Boateng GO, Neilands TB, Frongillo EA, Melgar-Quiñonez HR, Young SL. Best practices for developing and validating scales for health, social, and behavioral research: a primer. Front Public Health. 2018;6:149.

18. Hair JF, Black WC, Babin BJ, Anderson RE. Multivariate data analysis. Eighth. Pearson Education Limited. 2018.

19. Schober P, Boer C, Schwarte LA. Correlation coefficients: appropriate use and interpretation. Anesth Analg. 2018;126(5):1763-8.

20. Hajjar S. Statistical analysis: Internal-consistency reliability and construct validity. International Journal of Quantitative and Qualitative Research Methods. 2018;6(1):27-38.

21. Koo TK, Li MY. A guideline of selecting and reporting intraclass correlation coefficients for reliability research. J Chiropr Med. 2016;15(2):155-63.

22. Wuttge DM, Chaplin JE, Sandqvist G. Validation of the Swedish version of PROMIS-29v2 and FACIT-Dyspnea Index in patients with systemic sclerosis. Disabil Rehabil. 2023;45(15):2517-25.

23. Yount SE, Choi SW, Victorson D, Ruo B, Cella D, Anton S, et al. Brief, valid measures of dyspnea and related functional limitations in chronic obstructive pulmonary disease (COPD). Value Health. 2011;14(2):307-15.

24. Hinchcliff M, Beaumont JL, Thavarajah K, Varga J, Chung A, Podlusky S, et al. Validity of two new patient-reported outcome measures in systemic sclerosis: Patient-Reported Outcomes Measurement Information System 29-item Health Profile and Functional Assessment of Chronic Illness Therapy-Dyspnea short form. Arthritis Care Res (Hoboken). 2011;63(11):1620-8.

25. Shi D, Lee T, Maydeu-Olivares A. Understanding the model size effect on SEM Fit indices. Educ Psychol Meas. 2019;79(2):310-34.

26. Karagöz Y. SPSS ve AMOS uygulamalı nicel-nitel-karma bilimsel araştırma yöntemleri. Sivas: Nobel Akademik Yayıncılık Eğitim Danışmanlık Tic. Ltd. Şti; 2017.

27. Damani A, Ghoshal A, Salins N, Deodhar J, Muckaden M. Prevalence and intensity of dyspnea in advanced cancer and its impact on quality of life. Indian J Palliat Care. 2018;24(1):44-50.

28. Atlı A, Düger T. An evaluation of quality of life and muscle strength in adult cancer patients receiving treatment. Turk J Physiother Rehabil. 2020;31(3):288-97.

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DEPREM SONRASI TRAVMA DÜZEYİNİN BELİRLENMESİ VE FİZİKSEL AKTİVİTE DURUMU İLE İLİŞKİSİNİN İNCELENMESİ

ÖZ

Amaç: Çalışmanın amacı; 06 Şubat 2023'te meydana gelen Pazarcık-Elbistan merkezli depremler sebebiyle kişilerde oluşan travma düzeyinin, kişinin fiziksel aktivite durumu ile ilişkisini incelemektir. Aynı zamanda, kişilerde deprem sonrası ağrı varlığının sorgulanması ve bu durumun travma düzeyi ile ilişkisini ortaya koymaktır.

Yöntem: Veriler çevrimiçi olarak Google formları aracılığıyla toplandı, 18-65 yaş arası 388 gönüllü katılımcı (299 kadın, 89 erkek) çalışmaya dahil edildi. Katılımcıların genel özelliklerini belirlemek için "Sosyodemografik Bilgi Formu", travma düzeyini değerlendirmek için "Deprem Sonrası Travma Düzeyini Belirleme Ölçeği" (DSTDBÖ) ve fiziksel aktivite durumlarını belirlemek için "Uluslararası Fiziksel Aktivite Anketi Kısa Formu" (IPAQ-KF) kullanıldı.

Bulgular: Deprem bölgesinde bulunma durumuna göre DSTDBÖ genel puan ortalamaları arasında anlamlı fark saptandı ($p<0,001$). Deprem bölgesinde bulunan 126 kişinin DSTDBÖ genel puan ortalaması 57,66±19,87 iken, bölgede bulunmayan 262 kişinin ortalaması 49,00±18,49 olarak bulundu. Spearman korelasyon analiziyle deprem bölgesinde olan ve olmayan bireylerin IPAQ-KF toplam puanları, DSTDBÖ alt faktör ve toplam puanları arasındaki ilişki incelenmiş olup sadece "Bilişsel Yapılandırma" alt faktörü ile IPAQ-KF toplam puanları arasında anlamlı bir ilişkiyi yansıtmayan negatif zayıf ilişki bulundu (deprem bölgesinde olanlar için Spearman korelasyon katsayı değeri =-0,18, $p=0,042$). Ve deprem sonrası ağrı yaşayan bireylerin DSTDBÖ puanları, ağrı yaşamayanlardan daha yüksek olarak saptandı ($p=0,000$).

Sonuç: Bu çalışma ile deprem sonrası travma düzeyinin, fiziksel aktivite ile negatif ilişki gösterdiği belirlendi. İnaktif bireyler daha yüksek travma düzeylerine sahipken, minimal aktif bireylerde travma düzeyleri daha düşük bulundu. Bu bulgular, deprem sonrası fiziksel aktivitenin artırılmasının travma düzeylerini azaltmada etkili bir strateji olabileceğini göstermektedir. Bu alanda daha fazla araştırma, eğitim ve proje çalışmalarının yapılması gerekmektedir.

Anahtar Kelimeler: Deprem, Fiziksel aktivite, Fizyoterapi ve Rehabilitasyon, Travma

DETERMINATION OF POST-EARTHQUAKE TRAUMA LEVEL AND INVESTIGATION OF THE RELATIONSHIP WITH PHYSICAL ACTIVITY STATUS

ABSTRACT

Purpose: This study aims to examine the relationship between trauma levels caused by the February 6, 2023, Pazarcık-Elbistan earthquakes and individuals' physical activity status. It also aims to assess the presence of post-earthquake pain and its relationship with trauma levels.

Methods: The data were collected via Google Forms and completed by 388 voluntary participants (299 female, 89 male) aged 18-65 years. In the study, the "Sociodemographic Form" was used to determine the general characteristics, the "Scale for Determining the Level of Post-Earthquake Trauma" (PETLDS) was used to determine the level of trauma, and the "International Physical Activity Questionnaire Short Form" (IPAQ-SF) was used to determine the physical activity status.

Results: A significant difference was found in PETLDS scores based on residence in the earthquake-affected region ($p<0.001$); individuals in the region had higher scores (57.66±19.87) than those outside (49.00±18.49). Spearman's correlation analysis showed a weak negative correlation without statistical significance between the "Cognitive Restructuring" subscale and IPAQ-SF scores in individuals from the earthquake zone (Spearman's rank correlation coefficient =-0.18, $p=0.042$). Additionally, those who experienced post-earthquake pain had higher PETLDS scores than those who did not ($p=0.000$).

Conclusion: This study found a negative relationship between post-earthquake trauma levels and physical activity. While inactive individuals had higher trauma levels, minimally active individuals showed lower trauma levels. These findings suggest that increasing physical activity after an earthquake may be an effective strategy for reducing trauma levels. Further research, education, and project-based initiatives are needed in this field.

Keywords: Earthquake, Physical activity, Physiotherapy and Rehabilitation, Trauma

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GİRİŞ

Türkiye, Kuzey ve Doğu Anadolu fayı olmak üzere iki ana fay arasındaki Anadolu levhasında yer almaktadır ve deprem bölgesi olarak nitelendirilmektedir. Bundan dolayı deprem konusunda yapılacak çalışmalar Türkiye için büyük önem taşımaktadır. Ülkemizde sık sık farklı etki büyüklüğü ve yıkıcılıkta depremler yaşanmaktadır. Yakın zamanda 6 Şubat 2023 tarihinde, Boğaziçi Üniversitesi Kandilli Rasathanesi ve Deprem Araştırma Enstitü'nün verilerine göre 04.17 ve 13.24 saatlerinde Türkiye'nin güneydoğusu ve Suriye'nin bazı bölgelerinde 7,8 ve 7,6 şiddetinde iki büyük deprem meydana gelmiştir. Binalarda onarılamayacak derecede hasarların oluştuğu bu afette ne yazık ki çok sayıda insan yaralanmış ve hayatını kaybetmiştir (1-3).

Dünya üzerinde yeni hastalıkların oluşmasına, salgınların başlamasına, toplumsal ve çevresel değişikliklere neden olan doğal afetler, hem doğayı hem toplumu ilgilendiren yapıları sebebiyle geniş kapsamlı etkilere sahiptir (4,5). Bu etkiler, bireyler üzerinde fizyolojik, psikolojik ve sosyal anlamda yıkıcı sonuçlara sebep olmaktadır (6,7). Yüksek oranda can ve mal kaybı ile sonuçlanan doğal afetlerin başında ise deprem yer alır (8).

Deprem, yerkabuğunda meydana gelen sismik dalgalanmalar olarak tanımlanır ve fiziki hasarların yanında kişilerde travmaya sebebiyet vererek depresyon, travma sonrası stres bozukluğu (TSSB) gibi psikolojik sağlık sorunlarına neden olur (9) . Bunun yanı sıra, depremler bireylerin fiziksel sağlığını da olumsuz etkileyebilir. Deprem, deprem sonrası bireylerde en sık bildirilen ağrı bölgeleri arasında bel, boyun ve omuz yer almaktadır (10-12). Ayrıca, travmatik stresin ve fiziksel aktivite düzeyindeki değişimlerin kas-iskelet sistemi üzerindeki etkilerinin değerlendirilmesi gerektiği vurgulanmaktadır (11).

Travmatik olayların bireyler üzerindeki etkilerinden akut dönem ve travma sonrası dönem olarak söz edilebilmekle birlikte travmaya maruz kalan bireyler yaşadıkları olaylara genellikle birkaç hafta içerisinde kendiliğinden düzelen çeşitli tepkiler geliştirebilirler (13). Bu tepkiler Gyeongju'daki 2016 yılı depremzedeleri üzerine yapılan nitel bir araştırmada; yumuşak seslerle irkilme, depremlerin tekrarı konusunda endişeli olma ve rahat uyuyamama olarak bildirilmiştir (14). 2017 yılında yayınlanan bir başka çalışmada ise baş dönmesi, çarpıntı, baş ağrısı ve nefes darlığı gibi semptomların da deprem sonrası ortaya çıkabileceği belirlenmiştir (15).

Literatürde yer alan, 2009 depremi sırasında L'Aquila'da yaşayan 107 öğrencinin dahil edildiği çalışmada da, depremzedelerde genel bir kaygı ve tehdit beklentisi artışının yanı sıra uyku sorunlarına yönelik bir eğilim saptanmıştır (16). Bir diğer araştırma ise deprem bölgesinde yaşayan ve yaşamayan çocuk ve ergenlerde fiziksel aktivite seviyelerini incelemiş, deprem bölgesinde yaşayanların adım sayılarında düşüş olduğunu saptamış ve gelecekteki araştırmalarda fiziksel aktivitedeki değişikliklere katkıda bulunan demografik ve sosyokültürel faktörlerin irdelenmesini önermiştir (17). Nozue ve diğ. (18) yapmış olduğu çalışmada da depremzedelerde fiziksel aktivitenin fiziksel ve zihinsel sağlık ile ilişkili olduğu kanıtlanmış ve hayatta kalanların sağlık koşullarını iyileştirmek için fiziksel aktivite konusunda daha fazla müdahaleye ihtiyaç olduğu sonucuna varılmıştır.

Literatürden örnekler incelendiğinde depremlerin, bireylerde hem fiziksel hem de zihinsel etkilerinin olduğu özellikle fiziksel aktivite seviyesinde belirgin değişikliklere sebep olabildiği sonucuna ulaşılmaktadır. Fakat bilgimiz dahilinde deprem sonrası travma düzeyi ile kişinin fiziksel aktivite durumu arasındaki ilişkiyi inceleyen bir çalışma bulunmamaktadır.

Bu çalışmanın hipotezi, deprem sonrası travma düzeyinin bireylerin fiziksel aktivite durumunu anlamlı bir şekilde etkilediği yönündedir. Travma düzeyinin artmasıyla birlikte fiziksel aktivite seviyesinin azalacağı öngörülmektedir. Bu doğrultuda, 2023 Türkiye depremlerinde travmaya maruz kalan bireylerde, fiziksel aktivite düzeyi düşük olanların travma düzeylerinin fazla olacağı düşünülmektedir.

Aynı doğrultuda çalışmanın amacı, 2023 Türkiye depremlerinden etkilenen bireylerde travma düzeyini belirlemek ve bu düzey ile fiziksel aktivite seviyesi arasındaki ilişkiyi değerlendirerek korelasyonun büyüklüğünü ve yönünü analiz etmektir. Bunun yanı sıra, depremin fiziksel sağlığa etkilerini, özellikle ağrı ve ağrının olduğu bölgeleri saptamak ve cinsiyete göre fiziksel aktivite düzeyi ile davranış problemleri arasındaki farklılıkları değerlendirmek de çalışmanın amaçları arasındadır.

YÖNTEM

Kesitsel araştırma olarak planlanan bu araştırmadaki veriler Mart-Temmuz 2023 tarihleri arasında hem sosyal medya platformları üzerinden hem de erişebilen çevrede dahil edilme kriterlerini karşılayan bireylerden çevrimiçi anket (Google Formlar) aracılığı ile onam alındıktan sonra toplanılmaya başlanmış ve tüm maddelere eksiksiz cevap veren bireyler çalışmaya dahil edilmiştir. Araştırmanın örneklemi, sosyal medya platformları ve diğer çevrimiçi kanallar aracılığıyla yapılan duyurular sonucu gönüllü katılmak isteyen bireylerden oluşmaktadır. Çalışmaya dahil edilen bireyler, gönüllü katılım esasına dayalı olarak seçilmiştir. Türkiye'nin farklı illerinden başvuran bireyler, araştırmanın kriterlerini sağladıkları sürece çalışmaya dahil edilmiştir. Bu süreç, katılımcıların belirli bir seçime tabi tutulmaksızın, gönüllü katılım yoluyla gerçekleştirilmiştir. Örneklem büyüklüğün belirlenmesinde

evrendeki birim sayısının bilinmediği durumlarda kullanılan aşağıdaki formülden yararlanılmış (19,20) ve bu formüle göre örnek hacmi 384 olarak hesaplanmıştır.

$$\frac{n = t\ 2\ P\ (1\text{-}P)}{d\ 2}$$

n = örnek hacmi t = %95 önem düzeyine karşılık gelen tablo değeri (1,96) P = söz konusu olayın olma olasılığı (%50) d = örneklemede kabul edilen hata oranı (%5).

Çalışmaya dahil olma kriterleri bilgilendirme sonrası çalışmaya katılmayı kabul etmek, 18-65 yaş aralığında olmak, Türkçe dilini okuyup anlayabilme dil yeteneğine sahip olmaktır. Dışlanma kriterleri ise soruları anlama konusunda problem yaratabilecek kognitif hastalığa sahip olmak ve belirtilen yaş aralığında olmamak olarak belirlenmiştir. Bu doğrultuda çalışmamızda 388 katılımcıya ulaşılmıştır. Çevrimiçi veri toplamanın güvenilirliğini artırmak amacıyla, veri toplama süreci şeffaf bir şekilde katılımcılara açıklanmış ve katılımcıların doğru ve eksiksiz cevaplar vermeleri teşvik edilmiştir. Ancak, çevrimiçi veri toplama yönteminin getirdiği bazı sınırlılıklar ve güvenilirlik endişeleri göz önüne alındığında, bu araştırmanın sınırlılıklar kısmında bu durumu dikkate alarak bir risk planı önerilmiştir.

Araştırmanın etik onayı Fenerbahçe Üniversitesi Girişimsel Olmayan Klinik Araştırmalar Etik Kurulu'ndan (onay tarihi: 01.03.2023 ve protokol numarası: 48.2023fbu) onay alınmıştır.

Araştırmada Kullanılan Veri Toplama Araçları

Araştırmada katılımcıların sosyodemografik özelliklerini belirlemek için araştırmacılar tarafından oluşturulmuş Sosyodemografik Bilgi Formu, travma düzeyini belirlemek için Deprem Sonrası Travma Düzeyini Belirleme Ölçeği (DSTDBÖ) ve fiziksel aktivite düzeyinin değerlendirilmesi için de Uluslararası Fiziksel Aktivite Anketi Kısa Formu (IPAQ-KF) kullanılmıştır.

Sosyodemografik Bilgi Formu

Katılımcının yaş, boy, cinsiyet, medeni durum, kilo, eğitim durumu, ağrı yaşama durumu ve deprem maruziyet-etkilenim düzeylerini belirlemeye yönelik araştırmacılar tarafından oluşturulmuş formdur.

Uluslararası Fiziksel Aktivite Anketi- Kısa Formu

IPAQ-KF bireylerin fiziksel aktivite seviyelerini uluslararası standartta değerlendirmek amacıyla geliştirilmiştir. Saglam ve diğ. (21) tarafından IPAQ-KF ve Uzun Formlarının Türkçe geçerliği ve güvenirliği alınmıştır. Anket, bireylerin son yedi gün içerisindeki fiziksel aktivite düzeylerini şiddetli aktiviteler, orta şiddetli aktiviteler, yürüme ve oturma gibi dört bölümde değerlendirir. Toplam puan hesaplanırken, aktivitelere verilen metabolik eşdeğerleri (MET) (şiddetli aktivite =8 MET, orta şiddetli aktivite =4 MET, yürüme =3,3 MET) ile aktivitelerin yapılma süresi (dk) ve yapılma frekansı (gün sayısı) çarpılır ve kişinin haftalık MET-dk puanları elde edilir. Elde edilen puanlara göre bireylerin fiziksel aktivite düzeyleri "inaktif", "minimal aktif" ve "çok aktif" olmak üzere 3 kategoriye ayrılır (21).

Deprem Sonrası Travma Düzeyini Belirleme Ölçeği

DSTDBÖ 20 soruluk 5'li likert tipi cevaplı, "Davranış Problemleri", "Heyecansal Sınırlılık", "Duyusal", Bilişsel Yapılandırma" ve "Uyku Problemleri" olmak üzere 5 alt boyutludur. Yanıtlar; "Bana hiç uygun değil", "Bana biraz uygun", "Bana orta düzeyde uygun", "Bana çok uygun", "Bana tamamen uygun biçimindedir". Ölçekte ters madde bulunmamakta ve ölçekten alınacak puan 20 ile 100 arasında değişmektedir. Ölçekten alınan puanların artması bireylerin depremden etkilenme düzeylerinin arttığını göstermektedir (22).

İstatistiksel Analiz

Verilerin istatistiksel analizi "SPSS v29 (IBM Inc., Chicago, IL, USA)" paket programı kullanılarak yapıldı. Kategorik değişkenler için tanımlayıcı istatistikler frekans ve yüzde olarak verildi. Nicel değişkenlerin tanımlayıcı istatistikleri ortalama ± standart sapma sapma ve medyan (minimum-maksimum) değerleri ile verildi. Nümerik değişkenlerin normal dağılıma uygunluğu Kolmogorov-Smirnov testi ile değerlendirildi. Veri dağılımı normal olmadığı için gruplar arası karşılaştırmalarda [yaş, vücut kütle indeksi (VKİ), IPAQ-KF toplam puanı, DSTB alt skorları ve toplam puan] "Mann-Whitney U testi" kullanıldı. IPAQ-KF toplam puanları ve DSTB puanları arasındaki ilişkinin değerlendirilmesi için Spearman korelasyon testi kullanıldı. Pallant'ın (23) tanımlamasına göre ilişkinin kuvveti Spearman korelasyon katsayı değeri (rho) 0,10-0,29 arasındaysa zayıf, 0,30-0,49 arasındaysa orta ve 0,50-1 arasındaysa büyük olarak kabul edildi. Gruplar arası farklılaşmayı değerlendirmek için normal dağılım gösteren değişkenlerde "Independent sample t-test (Bağımsız örneklemler t-test)" kullanıldı. İkiden fazla bağımsız grup arasındaki niceliksel sürekli verilerin karşılaştırılmasında tek yönlü ANOVA testi kullanılmış olup, anlamlı fark bulunan değişkenlerde gruplar arasındaki farklılıkları belirlemek için tamamlayıcı post hoc analiz olarak Scheffé testi uygulanmıştır. Çalışmada tüm hesaplamalarda ve yorumlamalarda istatistik anlamlılık düzeyi "$p<0,05$, $p<0,01$, $p<0,001$" olarak dikkate alındı.

BULGULAR

Çalışmaya dahil olan katılımcıların tanımlayıcı özelliklerine yönelik bulgular Tablo 1'de yer almaktadır.

Tablo 1' de yer aldığı üzere 299'u kadın, 89'u erkek olan 388 katılımcının yaş ortalaması 29,8810,61 yıl, %64,4'ünün ise normal kilolu olduğu belirlenmiştir. Yüz yirmi altı'sının (%32,5) deprem sırasında afet ili ilan edilen bölgelerden birinde olduğu görülen katılımcıların deprem sonrası ağrı yaşama durumları

incelendiğinde 91 kişinin (%23,5) ağrı yaşadığı ve bu ağrıların özellikle baş (%39,6), boyun (%38,5) ve sırt (%37,4) bölgesinde yoğunlaştığı tespit edilmiştir.

Tablo 2'de belirtildiği gibi deprem bölgesinde olan bireylerin yaş ortalaması 31,6712,64, olmayan bireylerin ise 29,2010,25 olarak belirtilmiştir ve iki grup arasında yaş ortalaması arasında istatistiksel anlamlı fark bulunmuştur (p=0,039). DSTDBÖ alt faktörlerine bakıldığında deprem bölgesinde olan ve olmayanlar arasında; Davranış Problemleri (p<0,001), Heyecansal Sınırlılık (p=0,002), Duyuşsal (p=0,001), Bilişsel Yapılandırma (p<0,001), Uyku Problemleri (p<0,001) ve Toplam Değer (p<0,001) arasında istatistiksel anlamlı fark tespit edilmiştir. IPAQ-KF toplam puanları arasında ise istatistiksel anlamlı fark bulunmamıştır (p=0,548).

Çalışmaya katılan bireyler arasında deprem bölgesinde olanların (rho:-18 ve p=0,042) ve katılımcıların toplamının (rho:-10 ve p=0,042) IPAQ toplam puanları ile DSTDBÖ alt skorları ve toplam skorları arasındaki ilişki incelendiğinde sadece DSTDBÖ'nün Bilişsel Yapılandırma alt skoru ile IPAQ-KF toplam skoru arasında deprem bölgesinde olan katılımcılarda ve toplam katılımcılarda negatif zayıf ilişki (sırasıyla rho:-18, p=0,042 ve rho:-10, p=0,042) bulunmuştur. Katılımcı toplamındaki bu ilişkinin deprem bölgesinde olan gruptan kaynaklandığı anlaşılmaktadır (Tablo 3).

IPAQ-KF toplam puanları ile DSTDBÖ alt faktör ve toplam puanları arasındaki korelasyon katsayılarının katılımcıların cinsiyetlerine göre ayrımı Tablo 4'te gösterilmiştir.

Çalışmaya katılan kadın bireylerde ve toplam katılımcılarda, IPAQ-KF toplam puanları ile DSTDBÖ'nün "Davranış Problemleri" alt faktör puanları arasında zayıf negatif (kadın/rho =-16; p=0,005) (toplam/rho =-10; p=0,037) ve "Heyecansal Sınırlık" alt faktör puanları arasında zayıf negatif (kadın/rho =-22; p=0,001), (toplam/rho =-16; p=0,002) korelasyon olduğu bulunmuştur. Yine alt faktörler arasında yer alan "Bilişsel Yapılandırma" ile IPAQ-KF toplam puanları arasında erkek katılımcılarda (rho =-21; p=0,046) zayıf pozitif, kadın

Tablo 1. Bireylerin cinsiyetlerine göre tanımlayıcı istatistikleri

	Erkek (n=89)		Kadın (n=299)		Toplam (n=388)	
	n	%	n	%	n	%
Yaş (yıl) ($\bar{x} \pm SS$)	31,0012,32		29,5510,05		29,8810,61	
VKİ (kg/m²) ($\bar{x} \pm SS$)	25,06±3,71		23,194,01		23,624,01	
Deprem sonrası ağrı yaşama durumu						
Evet	17	19,10	74	24.74	91	23,50
Hayır	72	80,89	225	75,25	297	76,50
Deprem sonrası yaşanan ağrı bölgesi						
Baş	4	4,49	32	10,70	36	39,60
Boyun	7	7,86	28	9,36	35	38,50
Sırt	5	5,61	29	9,69	34	37,40
Bel	7	7,86	18	6,02	25	27,50
Karın	2	2,24	9	3,01	11	12,10
Omuz	2	2,24	5	1,67	7	7,70
Dirsek/el	3	3,37	7	2,34	10	11,00
Ayak	1	1,12	7	2,34	8	8,80
Bacak	4	4,49	17	5,68	21	23,10
VKİ grup						
Zayıf	1	1,10	21	7,00	22	5,70
Normal kilolu	45	50,60	205	68,60	250	64,40
Preobez	34	38,20	46	15,40	80	20,60
Obez	9	10,10	27	9,00	36	9,30
06.02.2023 tarihli Pazarcık ve Elbistan merkezli deprem esnasında afet bölgesi illerinde bulunma durumu						
Evet	27	30,30	99	33,10	126	32,50
Hayır	62	69,70	200	66,90	262	67,50

Birden fazla yanıt verilmiştir, VKİ: Vücut Kütle İndeksi, SS: Standat Sapma.

Tablo 2. Deprem bölgesinde olan ve olmayan bireylerin yaş, VKİ, IPAQ-KF toplam puanları ile DSTDBÖ alt faktör ve toplam puanlarının karşılaştırılması

	Deprem bölgesinde olan (n=126) Kadın n (%): 104 (82,50) Erkek n (%): 22 (17,50)		Deprem bölgesinde olmayan (n=262) Kadın n (%): 195 (74,40) Erkek n (%): 67 (25,60)		p
	Ortalama ± SS	Medyan (minimum-maksimum)	Ortalama ± SS	Medyan (minimum-maksimum)	
Yaş (yıl)	31,6712,64	27,5 (17-83)	29,2010,25	26 (18-89)	**0,039***
VKİ (kg/m²)	23,794,25	23,05 (16,53-36,29)	23,573,98	22,85 (16,67-35,6)	0,760
DSTDBÖ					
Davranış problemleri (4-20)	11,433,82	11 (4-20)	9,713,52	9 (4-20)	**<0,001***
Heyecansal sınırlılık (5-25)	13,80 6,06	13,5 (5-25)	11,805,70	10 (5-25)	**0,002***
Duyuşsal (4-20)	12,954,34	13 (4-20)	11,314,32	11 (4-20)	**0,001***
Bilişsel yapılandırma (4-20)	10,614,47	10 (4-20)	8,67 3,88	8 (4-20)	**<0,001***
Uyku problemleri (3-15)	8,843,62	9 (3-15)	7,493,43	7 (3-15)	**<0,001***
Toplam (20-100)	57,6619,87	57 (20-97)	4918,49	46 (20-97)	**<0,001***
IPAQ toplam puan	943,561839,75	148,5 (0-11088)	1253,622356,58	198 (0-13848)	0,548

*Mann-Whitney U test, VKİ: Vücut Kütle İndeksi, IPAQ-KF: Uluslararası Fiziksel Aktivite Anketi Kısa Formu, DSTDBÖ: Deprem Sonrası Travma Düzeyini Belirleme Ölçeği.

Tablo 3. Deprem bölgesinde olan ve olmayan bireylerin IPAQ-KF toplam puanları ile DSTDBÖ alt faktör ve toplam puanları arasındaki korelasyon katsayıları

DSTDBÖ	IPAQ toplam					
	Deprem bölgesinde olan (n=126)		Deprem bölgesinde olmayan (n=262)		Toplam n (=388)	
	rho	p	rho	p	rho	p
Davranış problemleri	-0,019	0,754	-0,019	0,754	-0,106	-0,052
Heyecansal sınırlık	-0,136	0,128	-0,078	0,206	-0,087	0,087
Duyuşsal	-0,112	0,212	-0,045	0,466	-0,075	0,140
Bilişsel yapılandırma	**-0,181**	**0,042***	-0,053	0,393	**-0,103**	**0,042***
Uyku problemleri	-0,078	0,384	-0,051	0,410	-0,072	0,160
Toplam	-0,145	0,106	-0,047	-0,447	-0,089	0,078

*p<0,05, rho: Spearman Korelasyon Katsayı Değeri, IPAQ-KF: Uluslararası Fiziksel Aktivite Anketi Kısa Formu, DSTDBÖ: Deprem Sonrası Travma Düzeyini Belirleme Ölçeği.

Tablo 4. Bireylerin cinsiyetlerine göre IPAQ-KF toplam puanları ile DSTDBÖ alt faktör ve toplam puanları arasındaki korelasyon katsayıları

	IPAQ toplam					
	Erkek		Kadın		Toplam	
	rho	p	rho	p	rho	p
Davranış problemleri	0,126	0,238	**-0,163**	**0,005****	**-0,106**	**0,037***
Heyecansal sınırlık	0,123	0,250	**-0,229**	**<0,001*****	**-0,160**	**0,002****
Duyuşsal	0,127	0,237	-0,058	0,319	-0,029	0,574
Bilişsel yapılandırma	**0,212**	**0,046***	**-0,131**	**0,024***	-0,063	0,216
Uyku problemleri	0,174	0,103	**-0,118**	**0,042***	-0,068	0,183
DSTDBÖ toplam	0,184	0,084	**-0,170**	**0,003****	-0,099	0,051

*p<0,05, **p<0,01, ***: p<0,001, rho: Spearman Korelasyon Katsayı Değeri, IPAQ-KF: Uluslararası Fiziksel Aktivite Anketi Kısa Formu, DSTDBÖ: Deprem Sonrası Travma Düzeyini Belirleme Ölçeği.

katılımcılarda ise (rho =-13; p=0,024) zayıf negatif ilişki görülmüştür. Bunların yanı sıra kadın katılımcılarda "Uyku Problemleri" ile IPAQ-KF toplam (rho =-11; p=0,042) ve DSTDBÖ ile IPAQ-KF toplam arasında (rho =-177; p=0,003) zayıf negatif ilişki olduğu belirlenmiştir.

DSTDBÖ'nün fiziksel aktivite durumlarına göre dağılımı Tablo 5'te belirtilmiştir.

DSTDBÖ puanlarının fiziksel aktivite durumuna göre anlamlı farklılık gösterdiği saptanmıştır ($F_{(2,\ 38)}$=3,82; p=0,02<0,05). IPAQ-KF göre inaktif olarak nitelendirilen katılımcıların travma toplam puanlarının ($\bar{x}$=54,131), minimal aktif olarak nitelendirilenler katılımcıların travma toplam puanlarından ($\bar{x}$=48,181) yüksek olduğu görülmüştür. Bu anlamlı farklılık Davranış Problemleri ($F_{(2,\ 385)}$=4,64; p=0,01<0,05) ve heyecansal sınırlık alt boyutlarında da belirlenmiştir. Duyuşsal, bilişsel yapılandırma, uyku problemleri alt boyutlarının puanları fiziksel aktivite durumuna göre anlamlı değişim göstermediği görülmüştür (p>0,05).

Çalışmaya katılan bireylerde ağrı yaşama durumuna göre DSTDBÖ değişim istatistikleri Tablo 6'da belirtilmiştir.

DSTDBÖ sonuçlarının ağrı yaşama durumuna göre anlamlı farklılık gösterdiği belirlenmiştir ($t_{(386)}$=8,762; p=0,000<0,05). Deprem sonrası ağrı yaşadığını bildirenlerin DSTDBÖ toplam puanları ($\bar{x}$=65,86), deprem sonrası ağrı yaşamayanların DSTDBÖ toplam puanlarından anlamlı derecece ($\bar{x}$=48,09) yüksek bulunmuştur. Bu anlamlılığın DSTDBÖ'nin tüm alt boyutları için korunduğu ağrı yaşayanların tüm alt boyutlar için anlamlı derecede daha yüksek travma düzeyi gösterdiği tespit edilmiştir.

TARTIŞMA

Bu çalışmanın sonucunda, deprem sırasında afet bölgesi ilan edilen ve edilmeyen bölgelerde bulunan katılımcıların DSTDBÖ genel puan ortalamasının orta düzey travma seviyesinde olduğu ve DSTDBÖ düzeylerinin fiziksel aktivite düzeyleri ile negatif bir ilişkiye sahip olduğu sonucuna varılmıştır. Deprem bölgesinde olan bireylerin yaş ortalamasının daha yüksek olması ve bu grubun DSTDBÖ alt faktörlerinde anlamlı fark göstermesi, yaşın ve deneyimlenen travmanın etkilerinin birbiriyle ilişkili olabileceğini düşündürmekte ve ilerleyen yaşın psikolojik travma belirtilerini artırabileceğini göstermektedir. Özellikle inaktif olan katılımcıların deprem sonrası travma düzeylerinin

Tablo 5. Deprem sonrası travma düzeyini belirleme ölçeği puanlarının fiziksel aktivite durumlarına göre karşılaştırılması

Gruplar	İnaktif	Minimal aktif	Çok aktif	F	p	Fark
	Ortalama ± SS	Ortalama ± SS	Ortalama ± SS			
Deprem sonrası travma toplam	54,13±19,31	48,18±16,72	51,97±16,92	3,820	**0,023**	**1>2**
Davranış problemleri	8,62±4,18	7,23±3,30	8,45±3,79	4,641	**0,010**	**1>2**
Heyecansal sınırlık	12,54±5,82	10,92±5,32	11,04±5,09	3,699	**0,026**	**1>2**
Duyuşsal	11,30±3,84	10,52±3,31	11,02±3,60	1,639	0,196	
Bilişsel yapılandırma	13,41±4,78	12,25±4,17	13,50±4,23	2,543	0,080	
Uyku problemleri	8,23±3,55	7,23±3,36	7,95±3,78	2,903	0,056	

Tek Yönlü Varyans Analizi, Post-hoc: Scheffé, SS: Standat Sapma.

Tablo 6. Ağrı yaşama durumuna göre DSTDBÖ puanlarının farklılaşma istatistikleri

	Ağrı yaşama durumu	n	Ortalama ± SS	t	SS	p
Deprem sonrası travma düzeyini belirleme ölçeği toplam	Evet	91	65,86±16,39	8,762	386	**<0,001*** **
	Hayır	297	48,09±17,08			
Davranış problemleri	Evet	91	11,04±4,28	8,432	386	**<0,001*** **
	Hayır	297	7,36±3,41			
Heyecansal sınırlık	Evet	91	15,08±5,52	6,397	386	**<0,001*** **
	Hayır	297	10,96±5,33			
Duyuşsal	Evet	91	13,31±3,19	7,100	386	**<0,001*** **
	Hayır	297	10,36±3,55			
Bilişsel yapılandırma	Evet	91	15,90±3,74	7,042	386	**<0,001*** **
	Hayır	297	12,25±4,47			
Uyku problemleri	Evet	91	10,51±3,20	8,655	386	**<0,001*** **

***p<0,00, Bağımsız Örneklem t-testi, DSTDBÖ: Deprem Sonrası Travma Düzeyini Belirleme Ölçeği, SS: Standart Sapma.

minimal aktif olanlara göre daha yüksek olması, fiziksel aktivitenin travma yönetiminde önemli bir rol oynayabileceğini ortaya koymaktadır. Ancak, IPAQ-KF toplam puanları ile DSTDBÖ toplam puanları arasında anlamlı bir ilişki bulunmaması, fiziksel aktivitenin travma düzeyi üzerindeki etkisinin karmaşık faktörlere bağlı olabileceğini göstermektedir. Bu karmaşıklık, travma sonrası dönemde bireyin destek sistemleri, sosyal bağları, geçmiş travma öyküsü ve psikolojik dayanıklılığı gibi çok sayıda psikososyal unsurun etkileşimiyle açıklanabilir (24).

Deprem gibi travmatik olayların, bireylerin fiziksel ve ruhsal sağlığı üzerindeki etkilerini göstermesi açısından önemli veriler içeren bu çalışmada; katılımcıların yaş ortalamasının genç yetişkin grubunda yoğunlaştığı ve büyük bir kısmının normal kilolu olduğu görülmektedir. Genç yetişkinlerin ve normal kilolu bireylerin diğer demografik özelliklere sahip bireylere kıyasla daha sağlıklı olabileceği bilinmektedir (25,26) ve bu bireylerde daha iyi bir sağlık durumu, daha az hastalık beklenmektedir. Çalışmamızda bu profildeki bireylerin çoğunlukta yer alması deprem gibi doğal afetlerin izole etkilerini anlamaya çalışmak, sağlıklı olduğunu düşündüğümüz bireylerde bu travmanın nasıl fiziksel ve psikolojik yansımalarının olabileceğini anlamak açısından önemlidir. Tüm katılımcıların birlikte değerlendirilmesinin yanısıra deprem bölgesinde bulunan ve bulunmayan kişilere göre yapılan analizlerin değerlendirilmesi de literatüre büyük katkı sağlayacaktır. Bu bağlamda yaptığımız analizlere göre deprem bölgesinde yaşayan ve yaşamayan katılımcılar arasındaki yaş ortalamasının anlamlı derecede farklı bulunması, deprem sonrası yaşanan travmanın yaş ile ilişkisini ayrıca incelemeyi gerektirmektedir. Yaş farkının travma düzeyine etkisi, yaşlı bireylerin deprem gibi afetlere karşı daha savunmasız olabileceğini; ancak bu çalışmada yaşa dayalı bir ilişki çıkmaması, bu değişkenin başka faktörler tarafından etkilenmiş olabileceğini düşündürmektedir. Nitekim, yaşla birlikte artan kronik hastalık yükü, bilişsel işlevlerdeki değişiklikler ve sosyal destek sistemlerindeki farklılıklar, travma deneyiminin birey üzerindeki etkilerini modüle edebilecek diğer önemli etkenler arasında yer alabilir.

Deprem bölgesinde olan katılımcıların travma düzeyinin yüksek olması, özellikle "Davranış Problemleri," "Heyecansal Sınırlık," "Bilişsel Yapılandırma," "Uyku Problemleri" gibi alt faktörlerde belirgin bir fark ortaya koyması, bu kişilerin afet sonrası psikolojik etkilerinin çok yönlü olduğunu göstermektedir. Bu bulgular, afet sonrası ortaya çıkan psikolojik rahatsızlıkların yalnızca doğrudan travma ile ilgili olmadığını, aynı zamanda afetin etkisiyle yaşanan fizyolojik değişimlerin ve çevresel stres faktörlerinin de önemli rol oynadığını ortaya koymaktadır. Bu tür alt faktörlerin üzerinde yapılan çalışmalar, bireylerin travmaya verdiği tepkilerin çok katmanlı bir yapıya sahip olduğunu ve bireysel farklılıkların büyük önem taşıdığını vurgulamaktadır. Dolayısıyla, afet sonrası ruh sağlığı müdahalelerinde bireysel farklılıkların, özellikle de daha önceki travma deneyimlerinin, baş etme stratejilerinin ve kişilik özelliklerinin dikkate alınması gerektiği anlaşılmaktadır.

Yine deprem bölgesinde olan ve olmayan bireylerin fiziksel aktivite düzeyi ile DSTDBÖ ile anlamlı bir ilişki göstermediği görülmüştür. Bu durum, fiziksel aktivitenin deprem sonrası travma belirtilerini doğrudan etkilemediğini gösterebilir. Ancak, deprem bölgesinde olan bireylerde, DSTDBÖ'nün bilişsel yapılandırma alt faktörü ile IPAQ toplam puanları arasında negatif bir ilişki tespit edilmiştir. Bu durum, fiziksel aktivitenin, özellikle bilişsel fonksiyonlar üzerindeki etkisinin travma belirtilerinin yönetilmesinde rol oynayabileceğini düşündürmektedir. Bu bulgu, deprem gibi travmatik olayların bireylerin psikolojik iyileşme süreçleriyle etkileşimde bulunabileceğini; ancak bu etkileşimin fiziksel aktivite ile doğrudan bir bağ kurmaktan çok daha karmaşık bir yapıda olduğunu ortaya koymaktadır. Özellikle aerobik egzersizin hipokampus ve prefrontal korteks gibi bilişsel işlevlerden sorumlu beyin bölgelerini olumlu yönde etkilediği bilinmektedir ve bu, bilişsel yapılandırma süreçlerinin güçlenmesine katkı sağlayabilir (27).

Çalışmada, deprem sırasında afet bölgesinde bulunan katılımcıların önemli bir kısmının deprem sonrası fiziksel ağrılar yaşadığı tespit edilmiştir. Bu ağrıların baş, boyun ve sırt bölgelerinde yoğunlaştığı görülmüştür. Bu bulgular, doğal afetlerin bireylerin fiziksel sağlığı üzerindeki etkilerini anlamak açısından önemli ipuçları sunmaktadır.

Baş ağrıları, genellikle stres ve psikolojik gerilim ile ilişkilendirilir (28,29). Deprem gibi travmatik olaylar, bireylerde yüksek düzeyde stres yaratabilir ve bu durum, baş ağrılarının sıklaşmasına yol açabilir. Benzer şekilde, boyun ve sırt ağrıları da stresin fizyolojik etkileri arasında yer alır. Bu tür ağrılar, kas gerginliği ve postüral değişiklikler gibi faktörlerle ilişkili olabilir. Araştırmalar travmatik deneyimlerin ardından bireylerin kas gerginliği ve ağrı bildirme olasılıklarının arttığını göstermektedir. Örneğin, doğal afetler sonrasında yapılan incelemeler, stres ve travmanın fiziksel belirtilerinin sıkça görüldüğünü ve bu belirtilerin genellikle baş, boyun ve sırt ağrıları şeklinde ortaya çıktığını göstermiştir (30,31). Stres ve anksiyetenin fizyolojik yansımaları, bu tür ağrıların yaygın olmasına katkıda bulunabilir.

Deprem sonrası fiziksel ağrı yaşayan bireylerin, DSTDBÖ daha yüksek puanlar aldığı görülmektedir. Deprem sonrası ağrı bildiren katılımcılar, DSTDBÖ'nün tüm alt boyutlarında anlamlı derecede daha yüksek puanlara sahiptir. Bu, fiziksel ağrıların psikolojik travma düzeylerini artırdığını ve travmatik olayların bireyler üzerindeki çok yönlü etkilerini vurgulamaktadır. Travmatik olaylar sonrası fiziksel ağrıların, stres ve anksiyete gibi psikolojik etkilerle yakından ilişkili olduğunu bilinmektedir. Örneğin, doğal afetler sonrasında yapılan

araştırmalarda, fiziksel ağrıların stres, anksiyete ve depresyon gibi psikolojik sorunlarla sıkça ilişkili olduğu bulunmuştur (30-32). Bu bulgular, travmatik bir deneyim sonrası fiziksel ağrıların sadece fiziksel bir sorun olmadığını, aynı zamanda psikolojik sağlık üzerinde de önemli etkileri olabileceğini göstermektedir. Çalışmamızda da görüldüğü gibi, ağrı yaşayan bireylerin DSTDBÖ alt boyutlarında anlamlı derecede daha yüksek puanlar alması, bu bağlantının ne kadar güçlü olduğunu vurgulamaktadır. Bu nedenle, afet sonrası sağlık müdahalelerinde fiziksel belirtilerin psikolojik değerlendirmelerle birlikte ele alınması bütüncül bir yaklaşım açısından önem taşımaktadır.

Literatürde yer alan araştırmalar, kadınların genellikle travmatik olaylara erkeklere kıyasla neredeyse 2 kat daha yüksek düzeyde psikolojik stres ve travma tepkisi verdiklerini ancak aynı zamanda daha düşük fiziksel aktivite düzeylerine sahip olduklarını ortaya koymuştur (33,34). Çalışmamızda, cinsiyetler arasında IPAQ-KF toplam puanları ile DSTDBÖ alt faktörleri arasındaki ilişkilerde belirgin farklar gözlemlenmiştir. Kadın katılımcılarda, fiziksel aktivite düzeyleri ile psikolojik sağlık parametreleri arasında anlamlı negatif ilişkiler bulunmuştur. Özellikle kadınların fiziksel aktivite düzeylerinin, davranışsal sorunlar ve heyecansal sınırlamalar gibi psikolojik sağlık sorunlarıyla ters bir ilişki içinde olduğu görülmüştür. Erkeklerde ise bilişsel yapılandırma ile fiziksel aktivite arasında pozitif bir ilişki tespit edilmiştir, ancak kadınlarda bu ilişki negatif yöndedir. Kadınlar ayrıca uyku problemleri ve fiziksel aktivite arasında da negatif bir ilişki göstermiştir. Bu bulgular, cinsiyetin, fiziksel aktivite ve psikolojik sağlık arasındaki etkileşimi şekillendiren önemli bir faktör olduğunu ortaya koymaktadır. Kadınlarda fiziksel aktivitenin psikolojik sağlık üzerindeki etkileri, erkeklere kıyasla daha farklı bir biçim alırken, bu farklılıkların, iyileşme süreçlerinde cinsiyetin rolünü anlamada dikkate alınması gerektiğini göstermektedir. Bu farklılıklar, kültürel roller, sosyal destek yapıları ve kadınların afet sonrası üstlendikleri bakım verme sorumlulukları gibi sosyokültürel etkenlerle de ilişkilendirilebilir (35).

Fiziksel aktivite, stres ve anksiyete ile başa çıkmada etkili bir araç olabilir ve bireylerin travmatik deneyimlerin ardından daha iyi psikolojik sağlık durumları sergilemelerine yardımcı olabilir. Bazı araştırmalar fiziksel aktivitenin sosyal etkileşimleri artırarak ve endorfin salınımını teşvik ederek psikolojik iyilik halini desteklediğini belirtmektedir (36,37). Bizim çalışmamızda da fiziksel aktivite düzeylerinin artmasıyla birlikte "Davranış Problemleri" ve "Heyecansal Sınırlık" puanlarında azalma görülmüştür. Fiziksel olarak inaktif olan katılımcıların travma puanları, minimal aktif olanlara göre daha yüksek çıkmıştır. Bu durum, fiziksel olarak daha aktif bireylerin, travma sonrası davranışsal ve duygusal sorunlar yaşama olasılığının daha düşük olduğunu, fiziksel aktivitenin travma sonrası psikolojik sağlık üzerinde koruyucu bir etkisi olabileceğini düşündürmektedir. Diğer araştırmalar da fiziksel aktivitenin, TSSB ve depresyon gibi psikolojik sorunların azaltılmasında olumlu etkileri olduğunu göstermiştir. Özellikle, düzenli fiziksel aktivitenin anksiyete ve depresyon düzeylerini düşürdüğü ve genel ruh halini iyileştirdiği bilinmektedir (38-40).

Ancak, duygu, bilişsel yapılandırma ve uyku problemleri alt boyutlarının puanları, fiziksel aktivite durumuna göre anlamlı değişim göstermemiştir. Bu durum, fiziksel aktivitenin her zaman tüm psikolojik sorunları çözmede yeterli olmayabileceğini ve bu alanlarda ek müdahalelerin gerekebileceğini düşündürmektedir. Örneğin, uyku problemleri, travmatik olaylar sonrası yaygın olarak görülür ve genellikle daha karmaşık tedavi yaklaşımları gerektirir. Diğer araştırmalar da, uyku kalitesini artırmak ve bilişsel işlevleri iyileştirmek için fiziksel aktivitenin yanı sıra, psikoterapi ve diğer tedavi yöntemlerinin birlikte kullanılmasının etkili olduğunu göstermektedir. Dolayısıyla, multidisipliner müdahale yaklaşımlarının, özellikle afet sonrası dönemlerde bireylerin bütünsel sağlığını desteklemede ön plana çıktığı görülmektedir.

Çalışmanın Güçlü ve Sınırlı Yönleri

Çalışmanın kısıtlılıkları ve güçlü yanlarını değerlendirdiğimizde, bazı önemli noktalar öne çıkmaktadır. Kısıtlılıklar arasında, katılımcıların büyük bir kısmının genç yetişkinlerden ve normal kilolu bireylerden oluşması, bulguların diğer yaş grupları ve farklı VKİ sahip bireyler için genellenebilirliğini sınırlamaktadır. Ayrıca, anket ve ölçeklere dayalı veriler, katılımcıların kendi bildirimlerine dayandığı için öznellik içerebilir, bu da veri doğruluğunu ve güvenilirliğini etkileyebilir. Çalışmada çevrimiçi veri toplama yöntemi kullanılmış olup, bu yöntem veri doğruluğu açısından bazı sınırlamalar taşımaktadır. Katılımcıların doğru ve eksiksiz yanıtlar verme konusunda yaşadığı olası zorluklar, veri kalitesini etkileyebilir. Fiziksel aktivite düzeyleri IPAQ-KF ile değerlendirilmiş olup, bu öz bildirime dayalı ölçüm yöntemi yerine gelecekteki çalışmalarda hızölçer (akselerometre) gibi nesnel araçların kullanılması önerilmektedir. Bu sayede fiziksel aktivitenin daha güvenilir ve hassas biçimde ölçülmesi sağlanabilir.

Çalışma, travma ve fiziksel aktivite arasındaki ilişkinin uzun dönem etkilerini değerlendirmemekte olup, uzun vadeli takip çalışmaları olmadan bu etkilerin sürdürülebilirliği hakkında kesin sonuçlar çıkarılamaz. Bölgesel sınırlamalar da mevcuttur; bulgular belirli bir coğrafi bölgedeki deprem mağdurlarına dayanmakta olup, farklı kültürel ve coğrafi koşullardaki bireyler için doğrudan geçerli olmayabilir. Ayrıca, elde edilen korelasyonların etki büyüklükleri zayıf düzeyde olduğundan, çalışmanın daha geniş, heterojen ve temsili örneklemlerle tekrarlanması, ilişkilerin gücünü daha net ortaya koyabilir.

Buna karşın, çalışmanın güçlü yanları da dikkate değerdir. Çalışma hem fiziksel hem de psikolojik iyilik hali üzerinde

detaylı analizler yaparak deprem sonrası travmanın çok yönlü etkilerini kapsamlı bir şekilde değerlendirmiştir. Erkek ve kadın katılımcılar arasındaki travma ve fiziksel aktivite farklılıklarını ortaya koyarak, cinsiyetin travma sonrası etkiler üzerindeki rolünü vurgulamaktadır. Fiziksel aktivitenin travma yönetimindeki rolünü belirleyerek, afet sonrası rehabilitasyon süreçlerinde uygulanabilecek somut öneriler sunması, rehabilitasyon programlarının daha etkili hale getirilmesine katkı sağlamaktadır. Deprem sonrası fiziksel ağrıların, özellikle baş, boyun ve sırt bölgelerinde yoğunlaştığını belirleyerek stresin fizyolojik yansımalarını göstermesi de literatüre yeni bilgiler kazandırmaktadır. Deprem bölgesinde olan ve olmayan kişiler arasındaki travma düzeyi ve fiziksel aktivite düzeyi arasındaki ilişkiyi net bir şekilde ortaya koyarak depremin bireyler üzerindeki etkilerini sunmaktadır. Çalışmanın istatistiksel analizlerinin bulguların anlamlı ve güvenilir olduğunu göstermesi, çalışmanın bilimsel değerini artıran önemli bir faktördür.

SONUÇ

Sonuç olarak çalışmamız, deprem sırasında afet bölgesi ilan edilen ve edilmeyen bölgelerde bulunan katılımcıların orta düzey travma seviyesinde olduğunu ve travma sonrası psikolojik etkilerinin fiziksel aktivite düzeyleri ile negatif ilişkiye sahip olduğunu ortaya koymaktadır. Fiziksel aktivite düzeylerinin artırılması, bu travmatik etkilerin azaltılması için önemli bir müdahale stratejisi olabilir. Fiziksel olarak inaktif katılımcıların, minimal aktif olanlara göre daha yüksek travma düzeyleri sergilemesi, fiziksel aktivitenin travma yönetiminde önemli bir rol oynayabileceğini göstermektedir. Genç yetişkin ve normal kilolu bireylerin ağırlıklı olarak katıldığı bu çalışmada, fiziksel ağrıların baş, boyun ve sırt bölgelerinde yoğunlaştığı tespit edilmiştir. Bu bulgular, travma sonrası fiziksel ağrıların psikolojik travmanın bir belirleyeni olduğunu göstermektedir. Fiziksel ağrıların psikolojik travma düzeylerini artırdığı ve cinsiyet farklılıklarının travma sonrası etkilerde belirgin olduğu görülmüştür. Cinsiyetin travma ve iyileşme süreçleri üzerindeki etkisi, daha kapsamlı cinsiyet odaklı rehabilitasyon programlarının gerekliliğini ortaya koymaktadır. Fiziksel aktivitenin artırılması, davranışsal ve duygusal sorunları hafifletmede etkili olabilirken, bazı psikolojik sorunlar için ek müdahalelere ihtiyaç duyulabilir. Bu bulgular, afet sonrası rehabilitasyon süreçlerinde fiziksel aktiviteyi teşvik eden programların geliştirilmesinin ve psikolojik iyileşmeye yönelik müdahalelerin gerekliliğinin yanı sıra, bu alanda daha fazla araştırma yapılmasının önemini vurgulamaktadır.

Ayrıca, afet bölgesi dışındaki bölgelerde de deprem sonrası travma ve fiziksel iyileşme süreçlerine dair farkındalık yaratılması gerektiği ortaya çıkmaktadır. Deprem gibi travmatik olayların ardından, fiziksel ve psikolojik rehabilitasyon hizmetlerinin etkin bir şekilde sağlanması gereklidir. Sağlık profesyonelleri, deprem mağdurlarının sadece fiziksel yaralanmalarını değil, aynı zamanda uzun vadeli fiziksel ve psikolojik etkilerini de göz önünde bulundurmalıdır. Bu çalışma ile travma sonrası rehabilitasyon hizmetlerinin kapsamlı bir şekilde planlanmasının önemi ortaya konulmuştur. Rehabilitasyon süreçlerinde multidisipliner bir yaklaşım benimsemek, afet sonrası iyileşme sürecini hızlandırabilir ve etkinliğini artırabilir. Bu bulgular, sağlık politikalarının şekillendirilmesinde ve deprem sonrası müdahalelerin planlanmasında dikkate alınmalıdır. Multidisipliner bir yaklaşım benimsenmesi, bireylerin daha hızlı ve etkili bir şekilde iyileşmesine katkıda bulunacaktır.

Ülkemiz Türkiye deprem bölgesinde olduğundan, koruyucu bir davranış olarak fiziksel aktivitenin deprem öncesi travma oluşmadan önce ve deprem sonrası travma oluşmasının ardından olmak üzere 2 aşamada da önemli olduğu hem koruyucu hem tedavi edici önemli bir bileşen olarak karşımıza çıktığı görülmektedir. Fiziksel aktivite, deprem öncesi hazırlık süreçlerinden, deprem sonrası iyileşme süreçlerine kadar, bireylerin travmadan daha hızlı toparlanmasını sağlayabilir. Deprem sadece deprem bölgesini değil tüm ülkeyi etkileyebilmektedir. Bu doğrultuda deprem sonrasına yönelik çalışmalar da sadece deprem bölgesini değil tüm ülkeyi kapsamalıdır. Afet sonrası rehabilitasyon programları, ülke genelinde oluşturulacak bir ağ ile, farklı bölgelerdeki bireylere yönelik daha etkili hale getirilebilir. Depremin toplum açısından hasarlarını onarabilmek için fizyoterapistler olarak fiziksel aktiviteyi artırma çalışmalarıyla sahada olmamızın ve fiziksel aktivitenin tüm yararlarını topluma sunabilmek için çeşitli araştırmalar, eğitimler ve projeler planlamamızın toplum için çok faydalı sonuçlar ortaya çıkaracağını düşünmekteyiz.

Etik Onay: Araştırmanın etik onayı Fenerbahçe Üniversitesi Girişimsel Olmayan Klinik Araştırmalar Etik Kurulu'ndan (onay tarihi: 01.03.2023 ve protokol numarası: 48.2023fbu) onay alınmıştır.

Hasta Onamı: Kesitsel araştırma olarak planlanan bu araştırmadaki veriler Mart-Temmuz 2023 tarihleri arasında hem sosyal medya platformları üzerinden hem de erişebilen çevrede dahil edilme kriterlerini karşılayan bireylerden çevrimiçi anket (Google Formlar) aracılığı ile onam alındıktan sonra toplanılmaya başlanmış ve tüm maddelere eksiksiz cevap veren bireyler çalışmaya dahil edilmiştir.

Destekleyen Kuruluş: Bulunmamaktadır.

Çıkar Çatışması: Bulunmamaktadır.

Yazar Katkıları: Fikir/Kavram- AT, NY, DT; Tasarım- AT, NY, DT; Denetleme/Danışmanlık- AT, DT; Materyaller- AT, NY, DT; Veri Toplama ve/veya Veri İşleme- AT, NY, DT; Analiz ve/veya Yorumlama- DT, NY; Literatür Taraması- AT, NY, DT; Makale Yazımı- AT, NY, DT; Eleştirel İnceleme AT, NY, DT.

Açıklamalar: Çalışma sözlü bildiri olarak 9. Ulusal Fizyoterapi ve Rehabilitasyon Kongresi'nde (2023) sunulmuştur.

Teşekkür: Bulunmamaktadır.

KAYNAKLAR

1. Yilmaz S, Tatliparmak AC, Karakayali O, Turk M, Uras N, Ipek M, et al. February 6th, Kahramanmaraş earthquakes and the disaster management algorithm of adult emergency medicine in Turkey: An experience review. Turk J Emerg Me. 2024;24(2):80-9.
2. Naddaf M. Turkey-Syria earthquake: what scientists know. Nature. 2023;614(7948):398-9.
3. Ni S, Sun H, Somerville P, Yuen DA, Milliner C, Wang H, et al. Complexities of the Turkey-Syria doublet earthquake sequence. Innovation (Camb). 2023;4(3):100431.
4. Sheikhbardsiri H, Yarmohammadian MH, Rezaei F, Maracy MR. Rehabilitation of vulnerable groups in emergencies and disasters: A systematic review. World J Emerg Med. 2017;8(4):253-63.
5. Wang C, Wu J, He X, Ye M, Liu W, Tang R. Emerging Trends and New Developments in Disaster Research after the 2008 Wenchuan Earthquake. Int J Environ Res Public Health. 2018;16(1):29.
6. Hahn MB, Van Wyck R, Lessard L, Fried R. Compounding Effects of Social Vulnerability and Recurring Natural Disasters on Mental and Physical Health. Disaster Med Public Health Prep. 2022;16(3):1013-21.
7. Saeed SA, Gargano SP. Natural disasters and mental health. Int Rev Psychiatry. 2022;34(1):16-25.
8. Li Y, Zhang Z, Wang W, Feng X. Rapid Estimation of Earthquake Fatalities in Mainland China Based on Physical Simulation and Empirical Statistics-A Case Study of the 2021 Yangbi Earthquake. Int J Environ Res Public Health. 2022;19(11):6820.
9. Tang W, Xu D, Yang Y, Xu J. Psychotic-like experiences in Chinese children and adolescents: The effect of earthquake exposure, maltreatment and negative life events. Early Interv Psychiatry. 2021;15(3):536-46.
10. Yabe Y, Hagiwara Y, Sekiguchi T, Sugawara Y, Tsuchiya M, Yoshida S, et al. Musculoskeletal pain in other body sites is associated with new-onset low back pain: a longitudinal study among survivors of the great East Japan earthquake. BMC Musculoskelet Disord. 2020;21(1):227.
11. Yabe Y, Hagiwara Y, Sekiguchi T, Sugawara Y, Tsuchiya M, Itaya N, et al. Musculoskeletal pain and new-onset poor physical function in elderly survivors of a natural disaster: a longitudinal study after the great East Japan earthquake. BMC Geriatr. 2019;19(1):274.
12. Hagiwara Y, Sekiguchi T, Yabe Y, Sugawara Y, Watanabe T, Kanazawa K, et al. Living status, economic hardship and sleep disturbance were associated with subjective shoulder pain in survivors of the Great East Japan Earthquake: A cross sectional study. J Orthop Sci. 2017;22(3):442-6.
13. Silwal S, Chudal R, Dybdahl R, Sillanmäki L, Lien L, Sourander A. Post-traumatic Stress and Depressive Symptoms Among Adolescents After the 2015 Earthquake in Nepal: A Longitudinal Study. Child Psychiatry Hum Dev. 2022;53(3):430-9.
14. Han YR, Jeong YW, Kim SK, Jeong HS. Changes in the Levels of Stress Perception, Experiencing Depressive Symptoms and Health-Related Quality of Life of Residents after the 2016 Gyeongju Earthquake. Int J Environ Res Public Health. 2021;18(2):540.
15. Zhang W, Ohira T, Yasumura S, Maeda M, Otsuru A, Harigane M, et al. Effects of socioeconomic factors on cardiovascular-related symptoms among residents in Fukushima after the Great East Japan Earthquake: a cross-sectional study using data from the Fukushima Health Management Survey. BMJ Open. 2017;7(6):e014077.
16. Pistoia F, Conson M, Carolei A, Dema MG, Splendiani A, Curcio G, et al. Post-earthquake Distress and Development of Emotional Expertise in Young Adults. Front Behav Neurosci. 2018;12:91.
17. Okazaki K, Suzuki K, Sakamoto Y, Sasaki K. Physical activity and sedentary behavior among children and adolescents living in an area affected by the 2011 Great East Japan earthquake and tsunami for 3 years. Prev Med Rep. 2015;2:720-4.
18. Nozue M, Nishi N, Tsubota-Utsugi M, Miyoshi M, Yonekura Y, Sakata K, et al. Combined associations of physical activity and dietary intake with health status among survivors of the Great East Japan Earthquake. Asia Pac J Clin Nutr. 2017;26(3):556-60.
19. Collins M. Sampling. In: Worcester RM, Downham J, eds. Consumer Market Research Handbook. 3rd ed. Maidenhead: Esomar; 1986.
20. Miran B. Temel İstatistik. İzmir: Ege Üniversitesi Basımevi; 2003. s.288.
21. Saglam M, Arikan H, Savci S, Inal-Ince D, Bosnak-Guclu M, Karabulut E, et al. International Physical Activity Questionnaire: Reliability and Validity of the Turkish Version. Percept Mot Skills. 2010;111(1):278-84.
22. Tanhan F, Kayri M. Deprem sonrası travma düzeyini belirleme ölçeğinin geçerlik ve güvenirlik çalışması. Kuram ve Uygulamada Eğitim Bilimleri. 2013;13(2):1013-25.
23. Pallant J. SPSS survival manual: a step by step guide to data analysis using SPSS for Windows. 3rd ed. Maidenhead: Open University Press; 2007.
24. Doğan M. Examining the Relationship between Psychological Resilience and Posttraumatic Growth: The Mediating Role of Positive and Negative Religious Coping. International Journal of Theological and Islamic Studies. 2023;65:127-62.
25. Payne ME, Porter Starr KN, Orenduff M, Mulder HS, McDonald SR, Spira AP, et al. Quality of Life and Mental Health in Older Adults with Obesity and Frailty: Associations with a Weight Loss Intervention. J Nutr Health Aging. 2018;22(10):1259-65.
26. Gürsoy Çuhadar S. The Active Aging Approach as a Solution to the Aging Population: Criticisms and Suggestions for a Possible Index for Turkey. Journal of Social Policy Conferences. 2020;79:361-97.
27. Dadkhah M, Saadat M, Ghorbanpour AM, Moradikor N. Experimental and clinical evidence of physical exercise on BDNF and cognitive function: A comprehensive review from molecular basis to therapy. Brain Behavior and Immunity Integrative. 2023;3:100017.
28. Onan D, Younis S, Wellsgatnik WD, Farham F, Andruškevičius S, Abashidze A, et al. Debate: differences and similarities between tension-type headache and migraine. J Headache Pain. 2023;24(1):92.
29. Turkistani A, Shah A, Jose AM, Melo JP, Luenam K, Ananias P, et al. Effectiveness of Manual Therapy and Acupuncture in Tension-Type Headache: A Systematic Review. Cureus. 2021;13(8):e17601.
30. Yabe Y, Hagiwara Y, Sekiguchi T, Sugawara Y, Tsuchiya M, Yoshida S, et al. The 5-Year Course of Neck Pain Among Natural Disaster Survivors: The Association of Prior Neck Pain with New Episodes of Neck Pain. Pain Med. 2022;23(4):635-41.
31. Sogi Y, Yabe Y, Hagiwara Y, Sekiguchi T, Sugawara Y, Tsuchiya M, et al. Association between continued residence in temporary prefabricated housing and musculoskeletal pain in survivors of the Great East Japan Earthquake: a longitudinal study. BMJ Open. 2019;9(10):e030761.
32. Jinnouchi H, Ohira T, Kakihana H, Matsudaira K, Maeda M, Yabe H, et al. Lifestyle factors associated with prevalent and exacerbated musculoskeletal pain after the Great East Japan Earthquake: a cross-sectional study from the Fukushima Health Management Survey. BMC Public Health. 2020;20(1):677.

33. Hiscox LV, Sharp TH, Olff M, Seedat S, Halligan SL. Sex-Based Contributors to and Consequences of Post-traumatic Stress Disorder. Curr Psychiatry Rep. 2023;25(5):233-45.

34. Kayantaş İ, Özdemir M, Buyrukoğlu E. Examination of Physical Activity Level in Terms of Gender (A Meta-Analysis Study)). Mediterranean Journal of Sport Science. 2022;5(Suppl 1):687-96.

35. Thurston AM, Stöckl H, Ranganathan M. Natural hazards, disasters and violence against women and girls: a global mixed-methods systematic review. BMJ Glob Health. 2021;6(4):e004377.

36. Rahmati M, Lee S, Yon DK, Lee SW, Udeh R, McEvoy M, et al. Physical activity and prevention of mental health complications: An umbrella review. Neurosci Biobehav Rev. 2024;160:105641.

37. Kandola A, Ashdown-Franks G, Hendrikse J, Sabiston CM, Stubbs B. Physical activity and depression: Towards understanding the antidepressant mechanisms of physical activity. Neurosci Biobehav Rev. 2019;107:525-39.

38. Herbert C. Enhancing Mental Health, Well-Being and Active Lifestyles of University Students by Means of Physical Activity and Exercise Research Programs. Front Public Health. 2022;10:849093.

39. Schuch FB, Vancampfort D. Physical activity, exercise, and mental disorders: it is time to move on. Trends Psychiatry Psychother. 2021;43(3):177-84.

40. Mahindru A, Patil P, Agrawal V. Role of Physical Activity on Mental Health and Well-Being: A Review. Cureus. 2023;15(1):e33475.

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COMPARISON OF THE EFFECTS OF NERVUS VAGUS STIMULATION, TENS, AND BACKUP STIMULATION DEVICE ON THE AUTONOMIC NERVOUS SYSTEM AND PAIN IN FIBROMYALGIA PATIENTS

ABSTRACT

Purpose: This study aimed to compare the acute effects of vagus nerve stimulation (VNS), transcutaneous electrical nerve stimulation (TENS), and the backup stimulation device (Backup) on pain, sympathetic, and parasympathetic nervous system functions in fibromyalgia patients.

Methods: Thirty fibromyalgia patients (aged 20-45) from a hospital in Bursa were randomly assigned to three groups: VNS, TENS, and Backup stimulation device. Each group received a 30-minute session once weekly for five sessions. Pain was assessed using the visual analog scale (VAS), and sympathetic and parasympathetic functions were measured with the Elite heart rate variability device. Parameters included heart rate, root mean square of successive differences, proportion of NN50 divided by total RR intervals, low-frequency/high-frequency (LF/HF) power, and LF/HF ratio.

Results: No significant post-intervention changes were found in autonomic parameters across groups ($p>0.05$). However, all groups showed a significant reduction in VAS scores ($p<0.05$), indicating effective pain relief. Heart rate significantly decreased only in the Backup group ($p<0.05$), suggesting a shift toward parasympathetic dominance. Between-group analysis revealed significant differences in VAS scores between the TENS and VNS groups, and the VNS and Backup groups ($p<0.05$), indicating variability in pain response.

Conclusion: TENS, VNS, and Backup stimulation devices effectively reduce pain in fibromyalgia patients. The heart rate reduction in the Backup group suggests a potential effect on autonomic regulation, which may offer a beneficial approach for managing fibromyalgia symptoms. Although autonomic parameters showed no significant changes overall, further research is needed to understand the long-term effects and clinical relevance of these treatments.

Keywords: Autonomic nervous system, Fibromyalgia, Nervus vagus stimulation, Pain

FİBROMİYALJİ HASTALARINDA NERVUS VAGUS STİMÜLASYONU, TENS VE BACKUP CİHAZ UYARIMININ OTONOM SİNİR SİSTEMİ VE AĞRI ÜZERİNDEKİ ETKİLERİNİN KARŞILAŞTIRILMASI

ÖZ

Amaç: Bu çalışmanın amacı, vagus siniri stimülasyonu (VNS), deriden elektriksel sinir stimülasyonu (TENS) ve yedek stimülasyon cihazı (Backup) uygulamalarının fibromiyalji hastalarında ağrı, sempatik ve parasempatik sinir sistemi fonksiyonları üzerindeki akut etkilerini karşılaştırmaktır.

Yöntem: Bursa'daki bir hastaneden 20-45 yaş arasındaki 30 fibromiyalji hastası rastgele üç gruba ayrıldı: VNS, TENS ve Backup. Her grup, haftada bir 30 dakikalık seans olmak üzere beş seans aldı. Ağrı, görsel analog skala (VAS) ile değerlendirildi, sempatik ve parasempatik fonksiyonlar ise Elite kalp hızı değişkenliği cihazı ile ölçüldü. Parametreler arasında kalp atım hızı, ardışık farkların karelerinin ortalaması, NN50'nin toplam RR aralıklarına oranı, düşük frekans/yüksek frekans (DF/YF) gücü ile DF/YF oranı yer aldı.

Bulgular: Gruplar arasında otonom parametrelerde müdahale sonrası anlamlı bir değişiklik gözlemlenmedi ($p>0,05$). Ancak, tüm gruplar VAS skorlarında anlamlı bir azalma gösterdi ($p<0,05$), bu da etkin bir ağrı hafiflemesi sağlandığını göstermektedir. Kalp atım hızı yalnızca Backup grubunda anlamlı şekilde azaldı ($p<0,05$), bu da parasempatik baskınlığa doğru bir kayma olduğunu düşündürmektedir. Gruplar arası analiz, TENS ve VNS grupları ile VNS ve yedek grupları arasında VAS skorlarında anlamlı farklar buldu ($p<0,05$), bu da ağrı yanıtındaki farklılıkları vurgulamaktadır.

Sonuç: TENS, VNS ve Backup'ları fibromiyalji hastalarında ağrıyı etkili bir şekilde azaltmaktadır. Yedek grupdaki kalp atım hızı azalması, otonom düzenleme üzerinde potansiyel bir etkisi olduğunu ve fibromiyalji semptomlarının yönetimi için faydalı bir yaklaşım sunabileceğini göstermektedir. Otonom parametrelerde genel olarak anlamlı bir değişiklik gözlemlenmemiş olsa da, bu bulgular bu tedavi yöntemlerinin uzun dönem etkileri ve klinik önemi hakkında daha fazla araştırma yapılması gerektiğini vurgulamaktadır.

Anahtar Kelimeler: Otonom sinir sistemi, Fibromiyalji, Nervus vagus uyarımı, Ağrı

INTRODUCTION

Fibromyalgia (FM) is a common chronic pain syndrome lasting at least three months and is characterized by symptoms such as hyperalgesia, allodynia, fatigue, cognitive impairment, sleep problems, and mood disorders (1). The American College of Rheumatology established the first criteria for FM diagnosis in 1990. These criteria include assessing pain in 19 different regions and calculating the Polysymptomatic Distress Scale score. An update in 2016 added a widespread pain criterion, and the scoring method was clarified (2). In 2021, the Analgesic, Anaesthetic, and Addiction Clinical Research Translations Innovations Opportunities and Networks group developed a simplified pain taxonomy for FM. According to these criteria, pain in at least 6 of 9 pain zones and moderate fatigue or sleep problems are sufficient to diagnose FM (3,4). FM occurs in 2-4% of the population and is more common in women than men. It is one of the most common causes of musculoskeletal pain in women aged 20-55 years (5).

There are widespread opinions that FM disease is caused by central nervous system dysfunction (6). The vagus nerve (VN), the tenth cranial nerve, is a complex parasympathetic nerve containing both afferent and efferent fibers (7) and plays an essential role in the neuroendocrine-immune network that ensures homeostasis (8,9). The VN integrates sensitive information and produces feedback responses by connecting with different brain regions. Studies show the effects of the VN on inflammation, mood, and pain regulation (10,11). Low vagal tone is expected in painful and inflammatory diseases such as FM, while the ventral branch of the VN is linked to emotional expression and social engagement. Therefore, the anti-inflammatory and psychological properties of the VN offer a potential therapeutic strategy in the treatment of FM (12). VN stimulation includes manual or electrotherapeutic methods that affect the VN. Animal experiments in the 1930s and 1940s showed that electrical stimulation (ES) affects brain electrical activity. The developed non-invasive method has attracted attention due to its easy applicability and minimization of potential risks. This method is applied through the external ear and is supplied by three sensory nerves (9).

VN stimulation has been shown to be an effective intervention for managing pain intensity in individuals with chronic pain (13). In a study, VN nerve stimulation was effective in pain, fatigue, and sleep disorders in people with FM (11). In a study comparing VN stimulation with diaphragmatic breathing in people with FM, the relationship between pain and change in heart rate (HR) was examined, and no significant difference was found in either group (14); another study showed that slow breathing combined with VN stimulation may be effective in pain, depression, anxiety and cardiovascular diseases (15).

Electrotherapy or ES interventions are non-invasive treatments that involve physical therapy interventions using electrical currents. ES is widely used in clinical interventions for pain relief and neuromuscular applications (16). Transcutaneous electrical nerve stimulation (TENS), a non-pharmacologic treatment, mainly involves the transmission of pulsed electrical currents across the intact surface of the skin to stimulate peripheral nerves for pain relief (17). TENS aims to stimulate low-threshold cutaneous afferents and close the pain gates to prevent the transmission of nociceptive information in the spinal cord and brainstem towards the upper centers and to relieve pain (18). In the literature, a double-blind study showed that low-frequency (LF) TENS decreased sympathetic nervous system activity and increased parasympathetic nervous system activity compared to the placebo group (19). There is also evidence that TENS can effectively reduce pain in individuals with FM in long-term applications with high or mixed frequencies, high intensity, and ten or more sessions (20). Studies have shown that TENS is effective in improving pain, disability, and quality of life in FM. It also increases pressure pain thresholds, enhances pain modulation, and, when combined with myofascial relaxation, improves cervical range of motion while reducing pain (17,21,22). Schwa Medico's BackUp system combines medium (interferential) and low frequency currents with heat to suppress pain perception and reduce pain in individuals affected by spinal problems. 80 Hz to 100 Hz applications inhibit the transmission of pain signals, while the current between 2 Hz and 15 Hz promotes the secretion of hormones that counteract pain. The combination of ES and heat has been shown to improve symptoms of chronic back pain in a study (23). The pathogenic involvement of the nervous system in FM and the numerous neurological and neuroinflammatory symptoms of this disease indicate that neuromodulatory stimulation techniques, which are effective and safe in various nervous system pathologies, can be utilized (18).

Studies have shown that TENS and VN stimulation have significant effects on the autonomic nervous system in individuals with FM (11,13-15,19,20). TENS has been widely used to manage pain and improve quality of life, while VN stimulation has been recognized for its potential in modulating autonomic function. Despite these findings, there is a lack of comparative studies evaluating the relative effectiveness of TENS and VN stimulation in FM patients. Furthermore, the Backup stimulation device, a relatively new intervention, has not yet been investigated for its effects on the autonomic nervous system or pain management in this population. This study aimed to address these gaps by comparing the effects of TENS, VN stimulation, and Backup stimulation device on pain and autonomic nervous system function in individuals with FM.

METHOD

Participants

Thirty individuals aged between 20 and 45 years with a mean age of 35.33 years who applied to the department of physical medicine and rehabilitation of a private hospital in Bursa and were diagnosed with FM by a physician were included in the study. Power and sample size calculations were conducted using G*Power version 3.1 software. To achieve a power of 0.80 with an effect size, we expected the study to be moderate, 0.50; at least ten patients in each group were required for recruitment. Participants were informed about the study's purpose, treatment duration, and the methods used during treatment. They signed the "Informed Voluntary Consent Form" prepared by the Ethics Committee standards, and permission for publication approval was obtained for the photographs to be used. The Clinical Research Ethics Committee approved the research on 06.02.2024 with the number E-10840098-202.3.02-1009 (decision no: 125).

Inclusion criteria: Participants must have a diagnosis of FM, be between the ages of 20 and 45, and have completed at least primary school education, ensuring they are literate.

Exclusion criteria: Participants will be excluded if they have a pacemaker, suffer from an orthopedic condition that prevents them from receiving treatment, or have issues with cooperation.

Study Plan

Eligible participants were provided with comprehensive explanations regarding the study methods and procedures. Following these explanations, individuals who voluntarily consented to participate and signed the informed consent form were included in the study.

Three groups were formed: vagus nerve stimulation (VNS) group (VSG), transcutaneous electrical stimulation group (TENSG), and Backup stimulation device group (BUG), consisting of a total of 30 participants who were randomly assigned based on their order of arrival. The TENSG group consisted of participants who arrived 1st, 4th, 7th, 10th, 13th, 16th, 19th, 22nd, 25th, and 28th, totaling 10 individuals. The BUG group included those who arrived 2nd, 5th, 8th, 11th, 14th, 17th, 20th, 23rd, 26th, and 29th, also comprising 10 participants. Finally, the VSG group consisted of participants who arrived 3rd, 6th, 9th, 12th, 15th, 18th, 21st, 24th, 27th, and 30th adding up to 10 participants as well. Therefore, each group contained 10 participants, ensuring an evenly distributed sample. A specialist physiotherapist treated patients allocated to the groups once a week for a total of five sessions. Since the Backup stimulation device was planned by the doctor to be used once a week, all three intervention groups received five sessions over a duration of five weeks. This schedule ensured an equitable evaluation of the treatments and allowed sufficient time for the body to recover between sessions, facilitating the monitoring of treatment effects.

VSG

The Vagustim device stimulated the ear bilaterally with electric current. Electrodes were placed on the concha and tragus parts of the ear (Figure 1). The current given was biphasic, the stimulation pulse width was 300 microseconds, and the frequency was 10 Hz. The current intensity was increased until the patient felt it, and it was applied for 20 minutes at this point (24).

TENSG

A TENS device applied a current with a frequency of 100 Hz. In the thoracic and lumbar region, self-adhesive personalized electrodes 5x5 were placed around the painful part (Figure 2), and the application was performed for 20 minutes (25).

BUG

Backup is a device that combines low frequency, medium frequency, and heat therapy. The whole spine is applied at the same time. A paper towel was laid on the device and wetted. Participants took off their clothes and lay down on the device. Exposed body parts were covered with a sheet. Calibration of the device was done specifically for each participant. The pain therapy application was selected from the device, and the current was increased until the patient felt it. Then, the pain therapy application was applied for 30 minutes (Figure 3). During the application, the participants were asked to avoid movements that would cause them to slip over the device (23).

Assessment Parameters

After the demographic information of the individuals included in the study was obtained.

Pre- and post-treatment pain assessment was measured using a visual analog scale (VAS), and the effects of treatments on the sympathetic and parasympathetic systems were measured and recorded using an Elite heart rate variability (HRV) device.

1. Demographic Information: A questionnaire was administered to gather demographic data from participants, including details such as age, gender, educational background, and body mass index (BMI).

2. Pain Assessment: Pain levels were evaluated using the VAS. This scale consists of a 10 cm line, with "0" at one end representing the absence of pain and "10" at the opposite end, signifying unbearable pain. Patients were provided with explanations regarding these endpoints and asked to mark the point on the scale that best de- described their current pain level.

3. Autonomic Nervous System Assessment: Evaluation of this system cannot be performed directly with physiologic tests. For this reason, clinical autonomic tests are usually evaluated regarding organ response to provocation of a specific physiological feature. As technology has improved, various assessment tools have been developed. New techniques such as HRV assessment and microneurography are being used. HRV analysis is based on observing R-R waves present during the resting state (26). HRV parameters are analyzed using time- and frequency-domain methods. These commonly used methods represent various ways to view the central tendency, variability, and HR distribution over time. HRV parameters consider the average values and overall magnitudes of fluctuations to quantify HR control over time. However, two individuals may have the same average R-R interval and HR responses to an event but vastly different variability of R-R intervals. The two most commonly accessible/used time-domain parameters are the standard deviation of the N-N intervals (SDNN) and the root mean square of the differences in adjacent N-N intervals (rMSSD). The SDNN represents a coarse quantification of HRV via autonomic regulation from sympathetic and parasympathetic inputs, while rMSSD represents parasympathetic activity. Unlike SDNN, rMSSD is void of HR slow-wave components, resulting in minimal respiratory influence and a more accurate representation of parasympathetic activity (27). Chen et al. (28) demonstrated the validity and reliability of Elite HRV.

The effects on the autonomic nervous system of the individuals participating in the study were measured with the Elite HRV device. The device has a finger sensor and a phone-compatible

Figure 1. Intervention of nervus vagus stimulation.

Figure 2. Intervention of TENS.
TENS: Transcutaneous Electrical Nerve Stimulation.

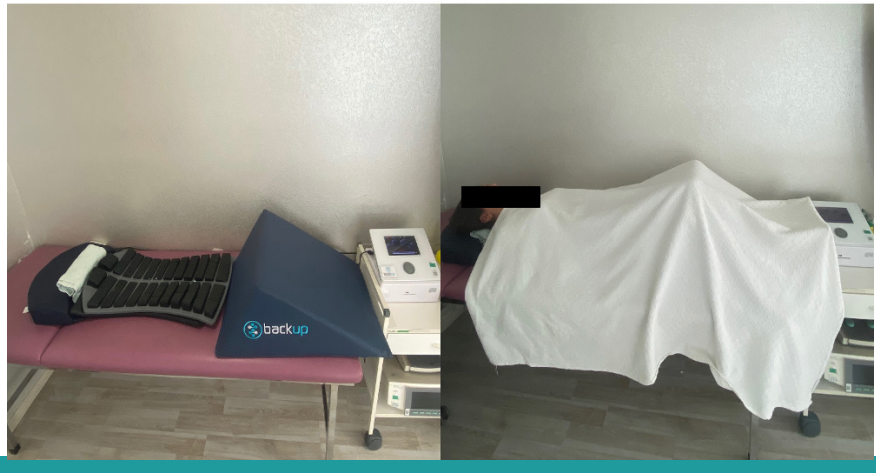

Figure 3. Intervention of Backup stimulation device.

application. The Elite HRV application is software that can synchronize with a personal monitor for instant HRV analysis by collecting R-R intervals (Figure 4). The participant breathed in and out for one minute in a sitting position under the guidance of the device, and the average of the measured values was automatically recorded in the system. The values measured with this device and their meanings are (29):

RMSSD: It is used for a snapshot of the parasympathetic branch of the autonomic nervous system and forms the basis of the HRV score.

PNN50: NN50 divided by the total number of NN (R-R) intervals.

LF power is the activity of the frequency range of 0.4-0.15 Hz. It is directly proportional to the activity of the sympathetic nervous system and represents sympathetic activity.

High-frequency (HF) Power: The frequency activity is 0.15 - 0.40 Hz. The HF band reflects parasympathetic activity and highly correlates with PNN50 and RMSSD time-domain measures.

LF/HF Ratio: The LF power to HF power ratio is commonly used to measure sympathovagal balance. It refers to the balance between opposing branches of the autonomic nervous system.

HR: It is the average value of the HR measured over one minute.

Statistical Analysis

Analyses were performed using SPSS (Statistical Package for the Social Sciences) version 25.0 (IBM et al., USA; https://www.ibm.com/products/spss-statistics; 2017). The normality of the collected data was tested using Kolmogorov-Smirnov and Shapiro-Wilk normality tests. Descriptive statistics of the data are given as minimum, maximum, median, and mean ± standard deviation for continuous variables and as numbers and percentages for categorical variables. The one-way analysis of variance (ANOVA) method was used to compare independent groups since there were three groups. Paired-t and Wilcoxon tests were used to compare repeated measurements, such as before and after the groups, since there were two groups. Statistical analysis of categorical data between the groups was also calculated using the "chi-square test". The results obtained were considered statistically significant at $p<0.05$.

RESULT

The 30 patients who participated in the study were randomized into three groups: 10 in TENS, 10 in VNS, and 10 in Backup stimulation device (Backup). Table 1 shows the sociodemographic characteristics of the participants. Of the participants, 22 (73.3%) were female and 8 (26.6%) were male. The mean age of the participants was 35.33 years, the mean

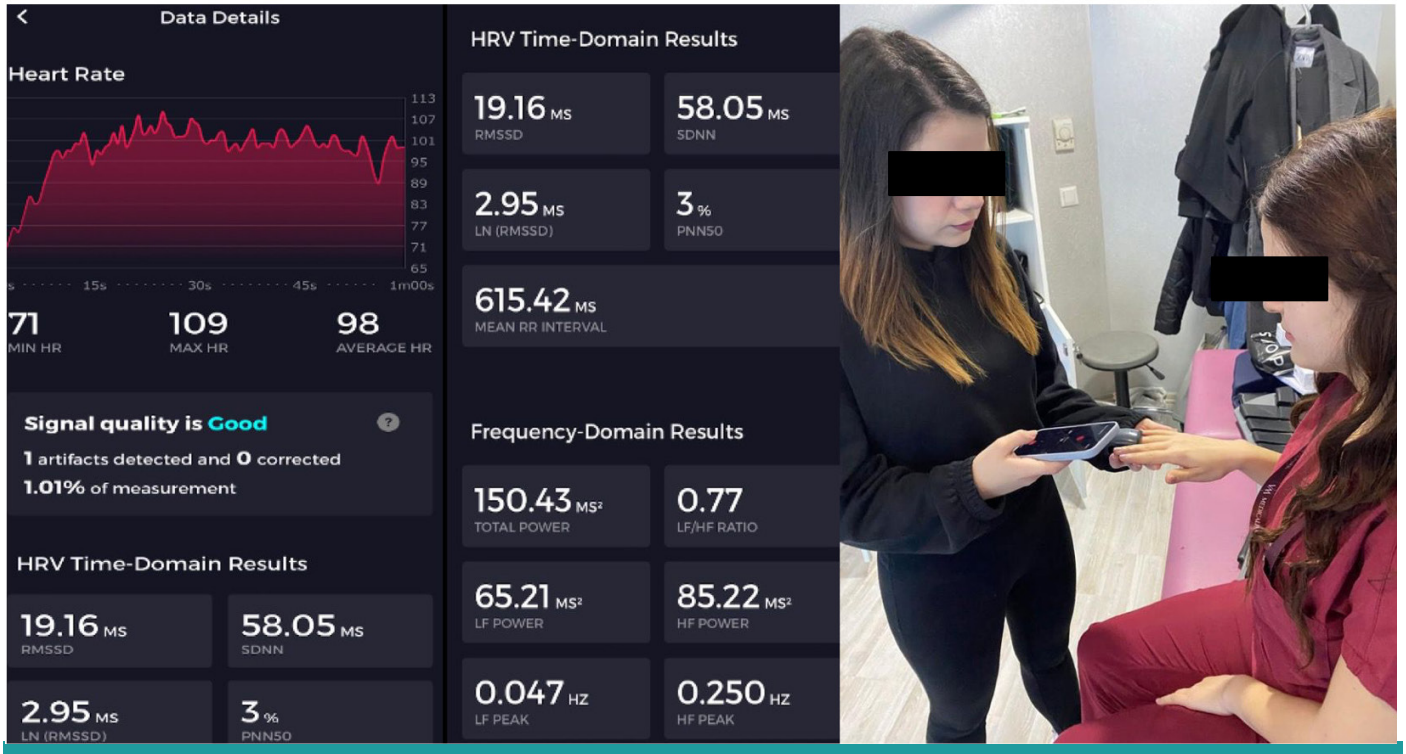

Figure 4. Elite HRV measurement and application interface.
HRV: Heart Rate Variability.

height was 167.46 cm, and the mean weight was 68.13 kg. The mean BMI was 24.42. Among the participants, 11 (36.6%) were university graduates, 11 (36.6%) were high school graduates, 2 (6.6%) were middle school graduates, and 6 (20%) were primary school graduates. There were no statistically significant differences in sociodemographic characteristics between the groups ($p>0.05$), indicating that pre-treatment values were homogeneously distributed.

The results of pre-and post-intervention evaluation in three groups are shown in Table 2. All participants completed the study. In the TENS group, an increase was observed in RMSSD and HF power values, indicating parasympathetic value, but no statistical significance was found. While there was no statistically significant difference between HR, PNN50, LF power, and LF/HF values before and after intervention ($p>0.05$), a statistically significant decrease was found in VAS value ($p<0.05$).

In the pre-and post-intervention evaluation results in VSG, a decrease was observed in RMSSD, PNN50, and HF power values reflecting parasympathetic values; however, no statistically significant difference was found. While the decrease in HR and LF/HF values before and after intervention was not statistically significant ($p>0.05$), the decrease in VAS value was statistically significant ($p<0.05$).

When the results of BUG evaluation before and after treatment were analyzed, the LF power value was analyzed, and it was observed that the sympathetic system increased before and after treatment. However, these results were not statistically significant ($p>0.05$). Similarly, there were no significant changes in RMSSD, PNN50, LF, HF power, and LF/HF values, whereas a statistically significant decrease was observed in HR and VAS values ($p<0.05$). To examine the differences among HR, RMSSD, PNN50, LF, HF, LF/HF, and VAS parameters in three groups consisting of a total of 30 patients (TENSG, VSG, and BUG), the medians of these parameters were compared using the one-way ANOVA test. When examining the statistical changes between groups, a significant difference was found in the VAS values . The analysis revealed a significant difference in the VAS parameter between at least two groups (Table 2). As shown in Table 3, according to the Wilcoxon signed-rank test, when the VAS values were analyzed between paired groups, a significant difference was observed between the TENSG and VSG groups ($p=0.000$), with the TENSG group showing a higher mean value (15.40) compared to the VSG group (5.60; $x^2=-3.804$). No significant difference was detected between the TENSG and BUG groups ($p=0.846$), as their mean values were similar (TENSG: 10.25, BUG: 10.75; $x^2=-0.994$). However, a significant difference was identified between the VSG and BUG groups ($p=0.000$), with the BUG group exhibiting a higher mean value (15.40) compared to the VSG group (5.60; $x^2=-3.822$). These findings emphasize the significant differences in VAS values, particularly between the VSG and BUG groups and the TENSG and VSG groups.

DISCUSSION

The primary findings of our study suggest that all three interventions -TENS, VNS, and Backup stimulation device- showed significant effects on both pain reduction and autonomic nervous system balance in patients with FM. Specifically, we observed a decrease in pain ($p<0.05$) and an increase in parasympathetic activity, as evidenced by changes in HRV parameters. Although statistical significance was not achieved for certain outcomes, such as HRV parameters ($p>0.05$), the general trend supports the positive impact of these treatments on the symptoms of FM, including both pain and autonomic dysfunction. The results contribute valuable insights into the potential of these non-pharmacologic interventions for managing FM (30,31).

Table 1. Sociodemographic information of participants

Groups		TENSG	VSG	BUG	p
Gender	Female	9 27%	7 (21%)	6 (18%)	0.071
	Male	1 3%	3 (9%)	4 (12%)	0.621
Age (year)		35	31.820	39.210	0.472
Height (cm)		162.42	170.33	169.71	0.788
Weight (kg)		63.82	68.47	72.22	0.821
BMI		24.04	23.52	25.26	0.231
Education status	Primary	3 (9%)	1 (3%)	2 (6%)	0.544
	Middle	1 (3%)	0	1 (3%)	0.500
	High	2 (6%)	4 (12%)	5 (15%)	0.593
	University	4 (12%)	5 (15%)	2 (6%)	0.117

TENSG: Transcutaneous Electrical Stimulation Group, VSG: Vagus Nerve Stimulation Group, BUG: Backup Group, BMI: Body Mass Index.

VNS, particularly transcutaneous VNS (tVNS), has garnered attention for its potential to influence the autonomic nervous system, particularly the parasympathetic branch. Our study found that tVNS led to a reduction in pain ($p<0.05$) and an increase in parasympathetic activity ($p>0.05$), as reflected in the HRV measurements. This finding is consistent with previous studies that have explored the role of VNS in FM and other conditions. In a study evaluating the effects of tVNS on pain in FM patients, 99 participants were assessed, and it was found that tVNS significantly improved pain scores ($p<0.05$) (32). Similarly, Kutlu et al. (9) conducted a study in which bilateral auricular tVNS combined with exercise therapy was shown to significantly reduce pain, anxiety, and depression ($p<0.05$), while also improving quality of life in FM patients. Our results are in line with these findings, as we observed positive effects on pain ($p<0.05$) and autonomic balance. However, no statistically significant change was observed in HRV parameters ($p>0.05$), which mirrors the results of a study by Paccione et

Table 2. TENS, vagus stimulation, and Backup groups intervention results

	Before median (min-max)	After median (min-max)	Intragroup analysis (p)	Inter group analysis (p)
HR				
TENSG	87.50 (75.25-99.75)	88.50 (82.20-90.25)	0.919	0.067
VSG	90 (79.5-96.5)	83.5 (78-92.5)	0.575	
BUG	86.50 (83.7-89.25)	79 (71-83.3)	**0.027***	
RMSSD				
TENSG	50.75 (37.74-67.66)	58.56 (34.35-77.09)	0.646	0.985
VSG	71.7 (33.9-99.4)	49.4 (25.4-93.1)	0.508	
BUG	44.25 (32.1-56.1)	55.50 (37.3-76)	0.241	
PNN50				
TENSG	22 (11.25-37.5)	19.50 (10.75-30)	0.445	0.791
VSG	24 (10.3-51)	14 (6.3-40.8)	0.373	
BUG	13.50 (6.7-29.7)	24.50 (12-30.3)	0.594	
LF power				
TENSG	932 (371-3218)	1094 (736-2702)	0.959	0.744
VSG	1061.7 (412.7-6242.6)	1005.8 (388.5-2566.6)	0.575	
BUG	1012.5 (424.6-2900.7)	1841 (355.3-2849.8)	0.878	
HF power				
TENSG	461.6 (303.6-1470)	629 (303-2026)	0.646	0.951
VSG	1399.7 (56.9-8510.2)	688.9 (266.3-2075.4)	0.646	
BUG	740.75 (290.5-2683.7)	587.5 (396.5-1197)	0.285	
LF/HF				
TENSG	1.99 (0.8-6.78)	1.97 (1.09-3.74)	0.799	0.897
VSG	1.8 (0.9-3.3)	1.46 (0.82-6.27)	0.878	
BUG	1.36 (0.38-3.9)	1.33 (0.83-4.3)	0.333	
VAS				
TENSG	7 (6-8)	4 (3-6)	**0.005***	**0.000****
VSG	8 (7-9)	5 (3.8-5)	**0.005***	
BUG	8 (7.75-8.25)	1 (1-1.25)	**0.004***	

*Kruskal-Wallis test $p<0.05$; **One-way ANOVA $p<0.05$, Min: Minimum, Max: Maximum, HR: Heart Rate, TENSG: Transcutaneous Electrical Stimulation Group, VSG: Vagus Nerve Stimulation Group, BUG: Backup Group, RMSSD: Root Mean Square Of The Successive Differences, PNN50: NN50 Divided by the Total Number of NN (R-R) Intervals, LF Power: Low-Frequency Power, HF Power: High-Frequency Power, VAS: Visual Analog Scale.

LF: Low-frequency, HF: High-frequency

Table 3. Inter group comparison of VAS parameters

Compared groups	n	Mean	x^2	p
TENSG - VSG	10	15.40	-3.804	**0.000***
	10	5.60		
TENSG - BUG	10	10.25	-0.994	0.846
	10	10.75		
VSG - BUG	10	5.60	-3.822	**0.000***
	10	15.40		

*Wilcoxon Signed-Rank Test $p<0.05$, N: Sample Size, x^2: Chi-Square Test, TENSG: Transcutaneous Electrical Stimulation Group, VSG: Vagus Nerve Stimulation Group, BUG: Backup Stimulation Device Group, VAS: Visual Analog Scale.

al. (14), who found no significant differences in HRV between active and placebo tVNS groups. While our study did not find statistical significance in heart rate measures ($p>0.05$), the observed changes in HRV suggest that tVNS may still play a role in modulating autonomic function in FM patients. Future studies with longer treatment periods and larger sample sizes are needed to confirm these findings and better understand the impact of VNS on FM symptoms.

TENS is widely used for managing pain in FM patients, with evidence suggesting that it can also affect autonomic nervous system activity. In our study, TENS was applied to the paravertebral region, and while we did not observe a significant decrease in heart rate ($p>0.05$), the reduction in the LF/HF ratio ($p<0.05$) suggests an increase in parasympathetic activity, aligning with findings from the existing literature. Previous studies have shown that TENS can reduce sympathetic nervous system activity and enhance parasympathetic tone, which plays a crucial role in managing stress and pain (33). For example, a study investigating TENS in hypertensive patients found that it decreased sympathetic activity while not altering blood pressure ($p>0.05$), which highlights its potential to modulate the autonomic nervous system without causing systemic changes (33). Our results suggest that TENS could be effective in managing both pain and autonomic dysregulation in FM patients. The lack of statistical significance in some outcomes ($p>0.05$) may reflect the need for longer treatment durations, larger sample sizes, or a more targeted application of TENS to better capture the effects on the autonomic nervous system.

Backup stimulation device is an emerging treatment modality that has not been widely studied in the context of FM. Our study is one of the first to investigate its effects on both pain relief ($p<0.05$) and autonomic nervous system balance ($p>0.05$). The results suggest that Backup stimulation device is effective in improving parasympathetic activation and reducing pain. Although no previous studies have specifically investigated the effects of the Backup stimulation device in FM patients, the findings from our study highlight its potential as a viable treatment option. We observed a similar increase in parasympathetic tone in the BUG ($p<0.05$) as seen in the TENS and VNS groups, with corresponding reductions in pain ($p<0.05$). This suggests that Backup stimulation device may offer similar benefits to other established treatments like TENS and VNS. The effectiveness of Backup stimulation device in improving autonomic balance and pain relief, despite its novelty, positions it as an important candidate for future research. Larger, well-controlled studies will be essential to establish the full potential of Backup stimulation device in FM management.

Our study adds to the growing body of evidence supporting the use of neuromodulatory interventions, such as TENS, VNS, and Backup stimulation device, in the treatment of FM. Previous studies have shown that FM is characterized by dysfunction of the autonomic nervous system, with increased sympathetic activity and decreased parasympathetic tone (34). For example, a study by Kutlu et al. (9) found that bilateral auricular tVNS, in combination with exercise therapy, significantly improved pain ($p<0.05$) and quality of life in FM patients, which is consistent with our findings of pain reduction ($p<0.05$) and increased parasympathetic activity. Additionally, research by Paccione et al. (14) highlighted the potential of tVNS in influencing autonomic function, though no significant changes in HRV were observed ($p>0.05$). Our study also found a decrease in the LF/HF ratio ($p<0.05$) in all three treatment groups, indicating a shift toward parasympathetic dominance, though statistical significance was not reached for all HRV parameters ($p>0.05$). This shift is consistent with studies showing that VNS and TENS can help restore autonomic balance in patients with conditions like FM (35). Our study extends this knowledge by investigating Backup stimulation device, which has shown promising results in improving autonomic function ($p<0.05$) and pain relief ($p<0.05$), but has not yet been studied extensively.

Limitations

This study has several limitations that should be acknowledged. First, the sample size was small, with only 10 participants per group, which may limit the statistical power to detect subtle differences in autonomic nervous system responses and may not

fully represent the broader population with FM. Future studies should consider a larger sample size to enhance statistical validity and generalizability. Second, the intervention duration was relatively short, limited to once-weekly sessions for five weeks. While this protocol aimed to capture initial responses, longer-term follow-up measurements would provide more insight into sustained effects and clinical applicability. Third, the study did not include a formal measure of physical activity level. Given that physical activity can influence autonomic responses, future research should incorporate this as a potential confounding factor or acknowledge it as a limitation in interpretation. Additionally, while Elite HRV was utilized for assessing HRV, details on the device's validity and reliability in clinical populations are limited. Including comprehensive device validation and exploring a range of HRV parameters would strengthen future work.

Another potential limitation is related to the Backup stimulation device. The feedback received from participants regarding the device could have influenced the outcomes. Patients' perceptions of the device and its comfort might have played a role in their response to the treatment, as this kind of neuromodulation can be affected by subjective factors such as expectations and comfort levels during the intervention. Future research should carefully control for these subjective factors and consider how they might influence the effectiveness of the Backup stimulation device.

Despite these limitations, this study provides a foundation for investigating the autonomic effects of TENS, VNS, and Backup interventions in managing FM, with implications for future research designs and larger-scale clinical trials.

CONCLUSION

The results of this study have significant implications for clinical practice. The positive effects of TENS, VNS, and Backup stimulation device on both pain ($p<0.05$) and autonomic regulation ($p>0.05$) suggest that these non-pharmacologic treatments could be valuable additions to the management of FM. Given that autonomic dysfunction is a hallmark of FM, restoring balance within the autonomic nervous system may lead to improved patient outcomes. Clinicians may consider incorporating TENS, VNS, or Backup stimulation device into their treatment protocols, depending on the patient's individual needs and response to therapy. However, as the current study was limited by sample size and treatment duration, further research with larger sample sizes, longer follow-up periods, and more detailed assessments of autonomic function is essential. Future studies should also explore the long-term effects of these treatments, as well as their potential to improve other quality-of-life measures in FM patients.

This study demonstrates that non-pharmacologic interventions, including TENS, VNS, and Backup stimulation device, are effective in managing pain and improving autonomic system balance in patients with FM. Although statistical significance was not reached in all outcomes, the results show promising trends in reducing pain and enhancing parasympathetic activity, which is crucial for managing FM symptoms.

These findings have important clinical implications. Given the limitations of pharmacological treatments, these non-invasive therapies offer a potential alternative or adjunct to traditional approaches. By targeting the autonomic nervous system, TENS, VNS, and Backup stimulation device can provide a more holistic solution to FM management, addressing both pain and the underlying autonomic dysfunction.

For healthcare professionals, incorporating these interventions into treatment plans could enhance patient outcomes, particularly for those who do not respond well to conventional medications. Future research should focus on larger samples and long-term effects to further assess their clinical efficacy.

Overall, this study highlights the potential of these non-invasive therapies to improve FM management, offering valuable insights for both clinical practice and future therapeutic strategies.

Ethics: The Medipol University Clinical Research Ethics Committee approved the research on 06.02.2024, with the number E-10840098-202.3.02-1009 (decision no: 125).

Informed Consent: Participants were informed about the study's purpose, treatment duration, and the methods used during treatment. They signed the "Informed Voluntary Consent Form" prepared by the Ethics Committee standards, and permission for publication approval was obtained for the photographs to be used.

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Conflict of Interest: Concept- GY, RK, EB; Design- GY, RK, EB; Supervision- GY; Materials- RK; Data Collection and/or Processing- GY, RK, EB; Analysis and/or Interpretation- GY, SK; Literature Search- GY, EB; Writing Manuscript- GY, RK, EB; Critical Review- GY.

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REFERENCES

1. Habibi Asgarabad M, Salehi Yegaei P, Jafari F, Azami-Aghdash S, Lumley MA. The relationship of alexithymia to pain and other symptoms

in fibromyalgia: a systematic review and meta-analysis. Eur J Pain. 2023;27(3):321-37.

2. Salaffi F, Di Carlo M, Farah S, Atzeni F, Buskila D, Ablin JN, et al. Diagnosis of fibromyalgia: comparison of the 2011/2016 ACR and AAPT criteria and validation of the modified Fibromyalgia Assessment Status. Rheumatology (Oxford). 2020;59(10):3042-9.
3. Pontes-Silva A, de Sousa AP, Dibai-Filho AV, de Souza MC, DeSantana JM, Avila MA. Do the instruments used to assess fibromyalgia symptoms according to American College of Rheumatology criteria generate similar scores in other chronic musculoskeletal pain? BMC Musculoskelet Disord. 2023;24(1):467.
4. Argaman Y, Granovsky Y, Sprecher E, Sinai A, Yarnitsky D, Weissman-Fogel I. Resting-state functional connectivity predicts motor cortex stimulation-dependent pain relief in fibromyalgia syndrome patients. Sci Rep. 2022;12(1):17135.
5. Häuser W, Brähler E, Ablin J, Wolfe F. Modified 2016 American College of Rheumatology Fibromyalgia Criteria, the Analgesic, Anesthetic, and Addiction Clinical Trial Translations Innovations Opportunities and Networks-American Pain Society Pain Taxonomy, and the Prevalence of Fibromyalgia. Arthritis Care Res (Hoboken). 2021;73(5):617-25.
6. Fors EA, Wensaas KA, Helvik AS. Prevalence and characteristics of fibromyalgia according to three fibromyalgia diagnostic criteria: a secondary analysis study. Scand J Pain. 2024;24(1):20230143.
7. Courties A, Berenbaum F, Sellam J. Vagus nerve stimulation in musculoskeletal diseases. Joint Bone Spine. 2021;88(3):105149.
8. Wang L, Gao F, Wang Z, Liang F, Dai Y, Wang M, et al. Transcutaneous auricular vagus nerve stimulation in the treatment of disorders of consciousness: mechanisms and applications. Front Neurosci. 2023;17:1286267.
9. Kutlu N, Özden AV, Alptekin HK, Alptekin JÖ. The impact of auricular vagus nerve stimulation on pain and life quality in patients with fibromyalgia syndrome. Biomed Res Int. 2020;28:8656218.
10. Mondal B, Choudhury S, Banerjee R, Roy A, Chatterjee K, Basu P, et al. Effects of non-invasive vagus nerve stimulation on clinical symptoms and molecular biomarkers in Parkinson's disease. Front Aging Neurosci. 2024;15:1331575.
11. Molero-Chamizo A, Nitsche MA, Bolz A, Andújar Barroso RT, Alameda Bailén JR, García Palomeque JC, et al. Non-invasive transcutaneous vagus nerve stimulation for the treatment of fibromyalgia symptoms: a study protocol. Brain Sci. 2022;12(1):95.
12. Martins DF, Viseux FJF, Salm DC, Ribeiro ACA, da Silva HKL, Seim LA, et al. The role of the vagus nerve in fibromyalgia syndrome. Neurosci Biobehav Rev. 2021;131:1136-49.
13. Costa V, Gianlorenço AC, Andrade MF, Camargo L, Menacho M, Arias Avila M, et al. Ranscutaneous vagus nerve stimulation effects on chronic pain: systematic review and meta-analysis. Pain Rep. 2024;9(5):e1171.
14. Paccione CE, Stubhaug A, Diep LM, Rosseland LA, Jacobsen HB. Meditative-based diaphragmatic breathing vs. vagus nerve stimulation in the treatment of fibromyalgia-A randomized controlled trial: body vs. machine. Front Neurol. 2022;13:1030927.
15. Szulczewski MT. Transcutaneous auricular vagus nerve stimulation combined with slow breathing: speculations on potential applications and technical considerations. Neuromodulation. 2022;25(3):380-94.
16. Johnson MI, Paley CA, Wittkopf PG, Mulvey MR, Jones G. Characterising the Features of 381 Clinical Studies Evaluating Transcutaneous Electrical Nerve Stimulation (TENS) for pain relief: a secondary analysis of the meta-TENS study to improve future research. Medicina (Kaunas). 2022;58(6):803.
17. García-López H, Calle-Ortega F, García-Robles P, Del-Rey RR, Obrero-Gaitán E, Cortés-Pérez I. Effectiveness of transcutaneous electrical nerve stimulation improves pain intensity, disability and quality of life in patients with fibromyalgia syndrome: a systematic review with meta-analysis. Disabil Rehabil. 2024;46(26):6323-33.
18. Cheng YC, Hsiao CY, Su MI, Chiu CC, Huang YC, Huang WL. Treating fibromyalgia with electrical neuromodulation: a systematic review and meta-analysis. Clin Neurophysiol. 2023;148:17-28.
19. do Amaral Sartori S, Stein C, Coronel CC, Macagnan FE, Plentz RDM. Effects of transcutaneous electrical nerve stimulation in autonomic nervous system of hypertensive patients: a randomized controlled trial. Curr Hypertens Rev. 2018;14(1):66-71.
20. Jurado-Priego LN, Cueto-Ureña C, Ramírez-Expósito MJ, Martínez-Martos JM. Fibromyalgia: a review of the pathophysiological mechanisms and multidisciplinary treatment strategies. Biomedicines. 2024;12(7):1543.
21. Berardi G, Dailey DL, Chimenti R, Merriwether E, Vance CGT, Rakel BA, et al. Influence of Transcutaneous Electrical Nerve Stimulation (TENS) on pressure pain thresholds and conditioned pain modulation in a randomized controlled trial in women with fibromyalgia. J Pain. 2024;25(6):104452.
22. Sagar K, Raja R. Comparative study on effectiveness of myofascial release technique along with ultrasound therapy V/S myofascial release technique along with transcutaneous electrical nerve stimulation in the fibromyalgia neck patients. Int J. Phys Educ Sports Health. 2022;9(5):231-7.
23. Back Up For a Strong Back. Findings related to currents used in pain therapy [Internet]. 2022 [updated 2022; cited 2024 Apr 5]. Available from: https://backupturkiye.com.
24. Gerges ANH, Williams EER, Hillier S, Uy J, Hamilton T, Chamberlain S, et al. Clinical application of transcutaneous auricular vagus nerve stimulation: a scoping review. Disabil Rehabil. 2024;46(24):5730-60.
25. Coskun Benlidayi I. The effectiveness and safety of electrotherapy in the management of fibromyalgia. Rheumatol Int. 2020;40(10):1571-80.
26. Di Credico A, Petri C, Cataldi S, Greco G, Suarez-Arrones L, Izzicupo P. Heart rate variability, recovery and stress analysis of an elite rally driver and co-driver during a competition period. Sci Prog. 2024;107(1):368504231223034.
27. Stephenson MD, Thompson AG, Merrigan JJ, Stone JD, Hagen JA. Applying heart rate variability to monitor health and performance in tactical personnel: a narrative review. Int J Environ Res Public Health. 2021;18(15):8143.
28. Chen YS, Lu WA, Pagaduan JC, Kuo CD. A novel smartphone app for the measurement of ultra-short-term and short-term heart rate variability: validity and reliability study. JMIR Mhealth Uhealth. 2020;8(7):e18761.
29. Maset-Roig R, Caplliure-Llopis J, de Bernardo N, Privado J, Alarcón-Jiménez J, Martín-Ruiz J, et al. Analysis of heart rate variability in individuals affected by amyotrophic lateral sclerosis. Sensors (Basel). 2024;24(7):2355.
30. Pinto AM, Luís M, Geenen R, Palavra F, Lumley MA, Ablin JN, et al. Neurophysiological and psychosocial mechanisms of fibromyalgia: a comprehensive review and call for an integrative model. Neurosci Biobehav Rev. 2023;151:105235.
31. Thieme K, Turk DC, Gracely RH, Maixner W, Flor H. The relationship among psychological and psychophysiological characteristics of fibromyalgia patients. J Pain. 2015;16(2):186-96.
32. Abdel-Baset AM, Abdellatif MA, Ahmed HH, El Shaarawy NK. Pain neuroscience education versus transcutaneous vagal nerve stimulation in the management of patients with fibromyalgia. Egypt Rheumatol. 2023;45(3):191-5.
33. Yokota H, Edama M, Hirabayashi R, Sekine C, Otsuru N, Saito K, et al. Effects of stimulus frequency, intensity, and sex on the autonomic response to transcutaneous vagus nerve stimulation. Brain Sci. 2022;12(8):1038.
34. Blase K, Vermetten E, Lehrer P, Gevirtz R. Neurophysiological approach by self-control of your stress-related autonomic nervous system with depression, stress and anxiety patients. Int J Environ Res Public Health. 2021;18(7):3329.
35. Paccione CE, Stubhaug A, Diep LM, Rosseland LA, Jacobsen HB. Meditative-based diaphragmatic breathing vs. vagus nerve stimulation in the treatment of fibromyalgia-A randomized controlled trial: body vs. machine. Front Neurol. 2022;13:1030927.

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TURKISH JOURNAL OF PHYSIOTHERAPY AND REHABILITATION
TÜRK FİZYOTERAPİ VE REHABİLİTASYON DERGİSİ

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FUNCTIONAL PERFORMANCE OF GERIATRIC INDIVIDUALS: A BIBLIOMETRIC OVERVIEW

ABSTRACT

Purpose: Functional performance reflects older adults' ability to perform work and daily living activities. The aim of this study is to analyze the articles on functional performance in older adults.

Methods: The Web of Science database was searched for the titles of English-language articles including "functional performance" and ("geriatric" OR "elderly" OR "aging" OR "older" OR "old age") words. Biblioshiny and VOSviewer software were used to present the thematic structure and mapping of analysis.

Results: A total of 154 English-articles published between the years 1995 and 2023 were included. The average citation per document was 31.47. The peak of the total citation count over years was seen in 1998 (9.4 citations). The year with the lowest average citation was 2003. The year with the highest number of publications was 2021. Brazil and the United States of America (USA) were the most productive and cited countries. The USA was the most relevant country, but only 5.13% of the publications were with multiple countries. Cress ME was the most relevant author. The most highly cited source was "Journal of the American Geriatrics Society". The most frequent word was "strength".

Conclusion: The results of this study provide important clues about the leading researchers and countries, and publication and citation potentials of studies regarding the functional performance of older individuals. The findings emphasize the significant deficiency in international cooperation; and provide the authors with valuable clues in determining original and specific goals for their future work on the subject and in realizing collaboration opportunities.

Keywords: Bibliometric analysis, Exercise, Functional status, Muscle strength, Old age

GERİATRİK BİREYLERİN FONKSİYONEL PERFORMANSI: BİBLİYOMETRİK BİR BAKIŞ

ÖZ

Amaç: Fonksiyonel performans, yaşlı yetişkinlerin iş ve günlük yaşam aktivitelerini gerçekleştirme becerilerini yansıtır. Bu çalışmanın amacı yaşlı yetişkinlerde fonksiyonel performansla ilgili makaleleri analiz etmektir.

Yöntem: Web of Science veri tabanında "functional performance" ve ("geriatric" OR "elderly" OR "aging" OR "older" OR "old age") kelimelerini içeren İngilizce makalelerin başlıkları arandı. Analizin tematik yapısını ve haritalamasını sunmak için Biblioshiny ve VOSviewer yazılımı kullanıldı.

Bulgular: 1995-2023 yılları arasında yayınlanan toplam 154 İngilizce makale çalışmaya dahil edildi. Belge başına ortalama atıf sayısı 31,47'dir. Yıllara göre toplam atıf sayısının zirvesi 1998 yılında görüldü (9,4 atıf). Ortalama atıf sayısının en düşük olduğu yıl 2003'tür. En fazla yayının yapıldığı yıl 2021'dir. Brezilya ve Amerika Birleşik Devletleri (ABD) en üretken ve en çok atıf alan ülkelerdi. Konuyla en ilgili yazarın Cress ME, ülkenin ise ABD olduğu, yayınların sadece %5,13'ünün farklı ülkelerle işbirliği ürünü olduğu görüldü. Konuya ilişkin yayınlarda en çok "Journal of the American Geriatrics Society"ye atıf yapıldığı ve yayınlarda en sık kullanılan kelimenin "strength (kuvvet)" olduğu saptandı.

Sonuç: Bu çalışmanın sonuçları, yaşlı bireylerde fonksiyonel performansa yönelik literatür örneklerinde ele alınan konular, önde gelen araştırmacılar, ülkeler ve de konuyla ilgili çalışmaların yayımlanma ve atıf alma potansiyeli konusunda önemli ipuçları sunmaktadır. Bulgular, uluslararası işbirliğindeki önemli eksikliği vurgulamakta olup yazarlara, konuya ilişkin gelecekteki çalışmaları için orijinal ve belirli hedefler belirlemede ve işbirliği fırsatlarının farkına varmada değerli ipuçları sağlamaktadır.

Anahtar Kelimeler: Bibliyometrik analiz, Egzersiz, Fonksiyonel durum, Kas kuvveti, Yaşlı

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INTRODUCTION

Functional performance reflects an individual's ability to perform work (1) and is an important determinant of older adults' ability to perform basic and instrumental activities of daily living (1,2). Assessment of functional performance in older adults generally involves assessment of changes in functional capacity (1).

Aging is a process associated with the deterioration of various physiological capacities such as muscle strength, aerobic capacity, neuro-motor coordination, and flexibility (3). These physiological impairments in turn, may predispose a range of functional limitations in older people (4), and aging is an independent risk factor for deterioration in functional capacity (5). As people grow older, changes in health status and an increasing prevalence of chronic diseases, may lead to difficulties in performing daily activities such as self-care, household maintenance, shopping, and other community activities, voluntary or work pursuits, and recreation and leisure activities (1). Assessment of functional performance is important for physiotherapists and other clinicians since it is an indicator of the mobility, lower and upper limb function, and competency in activities of daily living in older adults (1).

Health research, especially in the fields of geriatrics and gerontology, requires the analysis of complex biological, psychological, and social situations with advanced statistical tools (6). Professionals and scientists need various theoretical and practical tools to measure data. Bibliometrics is an important tool for assessing and analyzing the output of scientists, collaboration among universities, the impact of government science funding on national research, development performance, and educational effectiveness (7). Bibliometric analysis provides a quantitative examination of the literature (8), and network analysis describes multifactorial conditions and multiple variables considering a complex data structure (7). As highlighted in recent studies, bibliometric analysis allows researchers to track publications, funders, journals, and conceptual structures, offering a solution to the limitations of traditional methods in the face of exponential data growth (7,9).

Bibliometric analysis studies in the geriatrics and gerontology field are limited with the topics of physical activity, sarcopenia, Alzhemier's disease, dementia, and cardiac aging in the current literature (10-15). Although there are systematic review studies about functional performance in older adults in the literature (16-20) no bibliometric and network analysis studies exist, and there is a lack of knowledge about prominent researchers, institutions, and countries in this field.

This study aimed to analyze the studies related with the functional performance of older people from a bibliometric perspective, and to guide further clinical practice and research collaborations worldwide. The results of this study may help to guide future studies by showing out the properties and scope details of the most cited literature samples, presenting the issue trends, and therefore, may contribute to expanding and producing new knowledge regarding the subject.

METHOD

Study Design

This study has a bibliometric analysis design that reveals the bibliometric and intellectual structure by analyzing the social and structural relationships between different research parameters. The parameters analyzed in this research are publication outputs, research fields, authors, country-specific analysis, citation analysis and words.

Data Acquisition and Search Strategy

This study is based on the Web of Science (WoS) database that developed by Thomson Reuters (1990), is a platform based on web technology (21). The WoS database is almost one of the best standardized indices of research performance in different disciplines. It provides better graphics and more detailed citation analysis than other databases such as Scopus, PubMed, etc. (21). In this study, it was the preferred database in the analysis because it provides comprehensive data in terms of bibliometric information.

The keywords "functional performance" and ("geriatric" OR "elderly" OR "aging" OR "older" OR "old age") were searched On September 13, 2023.

A total of 258 publications were found. When only English language articles as document type were included, and other source types such as conference papers, reviews, data papers, editorial materials, and retracted papers were excluded, a total of 154 articles were found to be eligible for the data analysis.

After the first search, the literature was checked by two researchers (S.Y. and İ.Ç.K.) independently.

Analysis Tool and Data Analysis

The Bibliometrix package of R studio version (2023.06.1+524) was used for the bibliometric analysis (22). Biblioshiny - a web interface for bibliometrix is a Java software developed by Massimo Aria from the University of Naples Federico II (Italy) in 2019 (7). Biblioshiny combines the functionality of the bibliometrix package with the easy use of web apps through the Shiny package environment and is recommended to researchers who do not use codes for analysis (7). The analysis options are subdivided into seven categories as overview, sources, authors, documents, conceptual structures, intellectual structure, and social structure (7).

VOSviewer (The Centre for Science and Technology Studies, CWTS, Leiden, The Netherlands) (version 1.6.19) (23), a freely available software was used to run the analysis and mapping. VOSviewer analysis and visualized maps that can be connected based on co-authorship relations, co-occurrence citation, or co-citation link (23). The records of the search results were exported in plain text format for VOSviewer.

RESULTS

Publication Outputs

One hundred fifty-four English articles published between the years 1995 and 2023 were included in the study.

The number of relevant publications range from 1 to 15 per year, being the lowest in the years 1995, 1998, 2000, and 2003; and the highest in the year 2021.

The local-impact sources were measured using the high citation count (h-index), which was proposed by Jorge E Hirsch of the University of California, San Diego, USA, in 2005. It is a mixed quantitative metric used to assess the scholarly achievement of researchers. The higher the h-index, the greater the academic impact. The h-index indicates that a person has "h" papers, each of which has been cited at least "h" times in a given period (24). The average h-index of all articles was 38 based on the WoS database.

According to the local source impact analysis, *Archives of Gerontology and Geriatrics* (185 total citations in 2002), and *Archives of Physical Medicine and Rehabilitation* (with 326 total citations in 1996) were the journals with the highest h-index value (h-index: 5). *Age and Ageing, Journal of Strength and Conditioning Research,* and *Journal of the American Geriatrics Society* ranked third through fifth, with h-index of 4, and total citations of 406, 123 and 463, respectively.

The average citation per document was 31.47 between 1995 and 2023, and average citations per year was the highest in 1998 (9.4 citations), and the lowest in 2003 (0.1 citation).

Research Fields

The most productive research field was "Geriatrics-Gerontology" with 54 articles, followed by "Rehabilitation" with 32 articles. Gerontology and Sport Sciences with 30 articles, rank third and fourth. Orthopedics, Medicine General Internal, Public Environmental Occupational Health, Neurosciences, Nutrition Dietetics, Physiology, and Psychology are the other most productive research areas, respectively.

Authors

The number of publications of an author on a specific subject is considered an indicator of his/her scientific activity in this field. Biblioshiny-R output showed that Cress ME and Buchner DM were the first authors in this field by their publications in 1996. Cress ME, a well-known author who has published five articles on functional performance in geriatric individuals, can be considered as one of the most influential authors in this field, having contributed strongly to the academic literature on functional performance in older people. It can be seen that, the number of authors reached maximum between 2008 and 2016, and Bezerra ES, who began publishing in the relevant field in 2018 is the top author currently. Another finding of this study is that the average number of co-authors per document related with the functional performance of geriatric individuals is 5.38, and only 20.13% of the articles had international co-authorship (Figure 1).

The Most Relevant Authors, Journals, and Affiliations

Table 1 presents the most relevant authors, journals, and affiliations about functional performance of geriatric individuals. According to the number of relevant articles and citations, *Archives of Gerontology and Geriatrics* seems to be the most influential journal, and The Federal University of Minas Gerais in Brazil seems to be the most relevant institution in this field (Table 1).

Country-Specific Analysis

The top 10 most productive and cited countries are shown in Table 2. The most productive country was Brazil with 173 publications followed by the USA which was the most cited country with 2125 citations in this research field (Table 2).

The analysis of corresponding authors by countries is shown in Figure 2. Single Country Publications (SCP) show the number of the articles published by the authors from the same country, and Multiple Country Publications (MCP) indicate the articles published by the collaboration with other researchers from different countries. According to Figure 2, the USA is the most productive country with the highest number of corresponding authors in 39 articles (SCP: 37, and MCP: 2), followed by Brazil with 38 articles. While the publications of corresponding authors from China and Japan are all SCP, Brazil is the country with the highest number of MCPs (n=8). However, when the ratio of MCP over total number of publications is considered, Australia and Canada seem to be the countries with the highest collaboration of authors from different countries (Figure 2).

Citation Analysis

The most highly cited paper was written by Hurley et al. (25), in 1998 with 244 citations, and published in the "*Age and Ageing*" journal (Table 3). The functional performance of older people was assessed by timed up & go test, and stair ascent & descent tests, and was compared with those of healthy young and middle-aged subjects in this study (25).

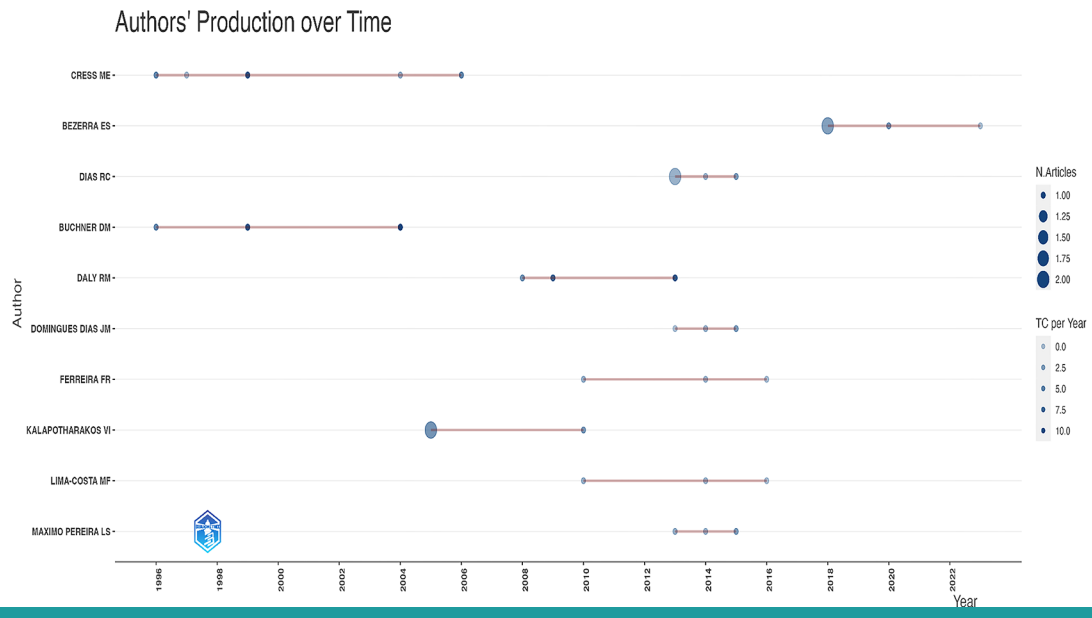

Figure 1. Authors' production over time.

Table 1. The top 10 most relevant authors, journals, and affiliations

	Author	Number of documents	Journal	Number of documents	Affiliation	Number of documents
1	Cress ME	5	Archives of Gerontology and Geriatrics	6	Univ Fed Minas Gerais	29
2	Bezerra ES	4	Archives of Physical Medicine and Rehabilitation	5	Univ Sao Paulo	19
3	Dias RC	4	Journal of Strength and Conditioning Research	5	Katholieke Univ Leuven	11
4	Bunchner DM	3	Age and Ageing	4	Vrije Univ Amsterdam	10
5	Daly RM	3	BMC Geriatrics	4	Univ Melbourne	9
6	Domingues Dias JM	3	Journal of Aging and Physical Activity	4	Univ Copenhagen	8
7	Ferreira FR	3	Journal of The American Geriatrics Society	4	Copenhagen Univ Hosp	7
8	Kalapotharakos VI	3	Topics in Geriatric Rehabilitation	4	Univ Georgia	7
9	Lima-Costa MF	3	Aging Clinical and Experimental Research	3	Univ Vienna	7
10	Maximo Pereirals	3	American Journal of Physical Medicine & Rehabilitation	3	Univ Washington	7

Words

The word cloud displays words in different sizes depending on how often they occur. The placement of the words is somewhat random, with dominant words placed in the center to make them more visible given the larger its size (26). A word cloud was created with Biblioshiny (R) to show the frequency of the keywords which occurred more than 10 times. It was found that "strength" (34 occurrences), "exercise" (33 occurrences), and "disability" (32 occurrences) were the most frequent words (Figure 3A).

Among the 366 keywords, 20 met the threshold of a minimum of 5 occurrences for mapping in VOSviewer. For each of the 20 keywords, the total strength of the co-occurrence links with other keywords was analyzed. As shown in Figure 3B, the most frequent keywords fall into four clusters.

Cluster 1 was the largest cluster, with eight keywords marked in red circle, mainly related to "muscle strength", "balance", "elderly", and "functional performance", "gait", "physical function", "sarcopenia", and "strength training" (Figure 3B).

Cluster 2 was marked in green circles and included six keywords: "aged", "cognition", "physical fitness", "physical functional performance", "rehabilitation", and "resistance training" (Figure 3B).

Cluster 3 with three keywords was marked in blue circles, including "aging", "exercise", and "strength" (Figure 3B).

Table 2. The top 10 most productive and cited countries

	Most productive countries	Frequency	Most cited countries	Number
1	Brazil	173	USA	2125
2	USA	166	Brazil	792
3	Denmark	43	Australia	459
4	China	38	United Kingdom	281
5	Australia	36	Netherlands	174
6	Netherlands	31	Canada	147
7	Spain	26	Belgium	136
8	Canada	19	Finland	128
9	Belgium	18	Denmark	114
10	Japan	14	Greece	114

USA: United States of America.

Cluster 4 consists of three keywords marked in a yellow circle. The keywords included "activities of daily living", "older adults", and "physical activity" (Figure 3B).

The term "aging" occurred 27 times and had 28 total link strength in the blue circle. The term "functional performance" occurred 20 times (10 link, 17 total link strength), and "muscle strength" occurred 19 times (14 links, 29 total link strength) (Figure 3B).

DISCUSSION

The analysis of the literature shows that the publications related with functional performance in older people, fluctuated at low levels during the initial periods of 1995. However, the number of publications increased rapidly between 2017 and 2021, reaching the highest level in 2021 with only 15 articles. A number as low as 15, even in the highest period, suggests that there is not enough interest in this field or that sufficient publication conditions have not been achieved by the researchers.

Geriatrics and Gerontology is the most productive research field, and followed by *Rehabilitation* in present study. Functional performance is important not only for determining functional status, but also for monitoring the overall clinical development of older adults (27). In the context of rehabilitation strategies, it is important in the older population to assess and reach the optimal level of functional performance, as this predicts falls, adverse health events and deaths (27,28). From this point of view, it is thought that *Geriatrics and Gerontology* rank first,

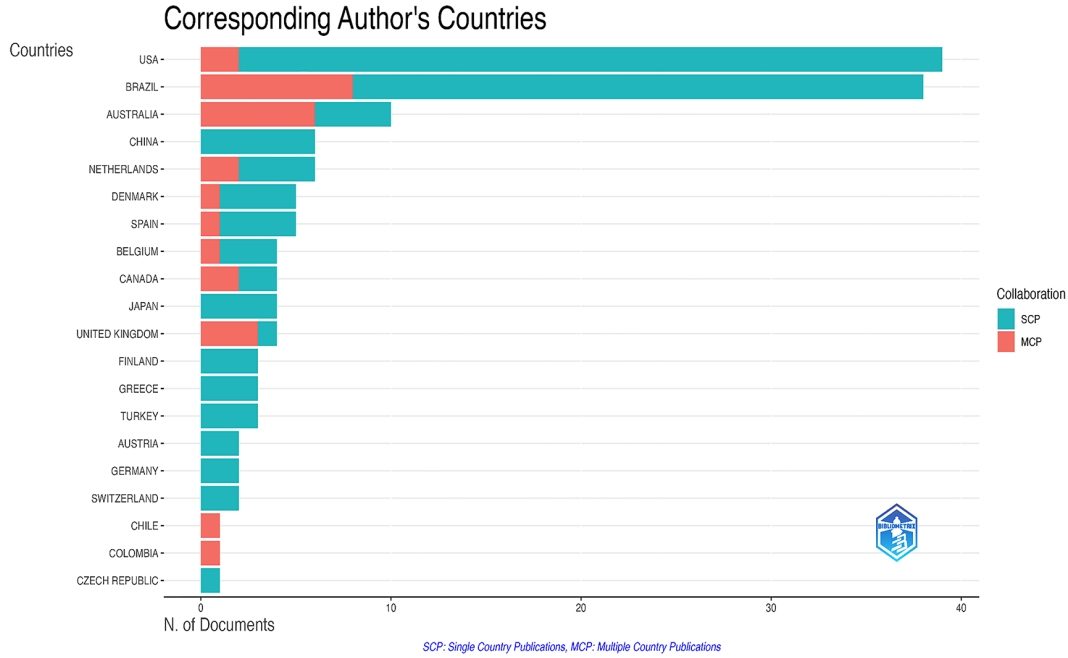

Figure 2. Corresponding authors' countries analysis.

Table 3. The 10 most cited papers

	Title	First author	Journal	Year	Total Citation	Journal Citation Indicator™ (2023)	Quartile
1	Quadriceps function, proprioceptive acuity and functional performance in healthy young, middle-aged and elderly subjects	Hurley MV	Age and Ageing	1998	244	1.42	Q1 (GERIATRICS & GERONTOLOGY in SCIE edition)
2	Muscle power of the ankle flexors predicts functional performance in community-dwelling older women	Suzuki T	J Am Geriatr Soc	2001	236	1.31	Q1 (GERIATRICS & GERONTOLOGY in SCIE; and GERONTOLOGY in SSCI edition)
3	Exercise: effects on physical functional performance in independent older adults	Cress ME	J Gerontol A Biol Sci Med Sci	1999	230	1.39	Q2 (GERIATRICS & GERONTOLOGY in SCIE edition) Q1 (GERONTOLOGY in SSCI edition)
4	The effects of multidimensional home-based exercise on functional performance in elderly people	Nelson Me	J Gerontol A Biol Sci Med Sci	2004	214	1.39	Q2 (GERIATRICS & GERONTOLOGY in SCIE edition) Q1 (GERONTOLOGY in SSCI edition)
5	Effect of high versus low-velocity resistance training on muscular fitness and functional performance in older men	Bottaro M	Eur J Apple Physıol	2007	199	0.96	Q2 (PHYSIOLOGY in SCIE edition, and SPORT SCIENCES in SCIE edition)
6	Association between executive attention and physical functional performance in community-dwelling older women	Carlson MC	J Gerontol B Psychol Sci Soc Sci	1999	154	1.79	Q1 (GERIATRICS & GERONTOLOGY in SCIE edition) (GERONTOLOGY in SSCI edition)
7	Impaired aerobic capacity and physical functional performance in older heart failure patients with preserved ejection fraction: role of lean body mass	Haykowsky MJ	J Gerontol A Biol Sci Med Sci	2013	128	1.39	Q2 (GERIATRICS & GERONTOLOGY in SCIE edition) Q1 (GERONTOLOGY in SSCI edition)
8	Continuous-scale physical functional performance in healthy older adults: a validation study	Cress ME	Arch Phys Med Rehabil	1996	123	1.63	Q1 (REHABILITATION in SCIE edition) (SPORT SCIENCES in SCIE edition)
9	Cognitive correlates of functional performance in older adults: comparison of self-report, direct observation, and performance-based measures	Schmitter-Edgecombe M	J Int Neuropsychol Soc	2011	112	0.84	Q2 (PSYCHOLOGY in SCIE edition) Q3 (PSYCHOLOGY, CLINICAL in SSCI edition)
10	Effects of resistance exercise and fortified milk on skeletal muscle mass, muscle size, and functional performance in middle-aged and older men: an 18-mo randomized controlled trial	Kukuljan S	J Appl Physiol	2009	109	1.27	Q2 (PHYSIOLOGY in SCIE edition, and SPORT SCIENCES in SCIE edition)

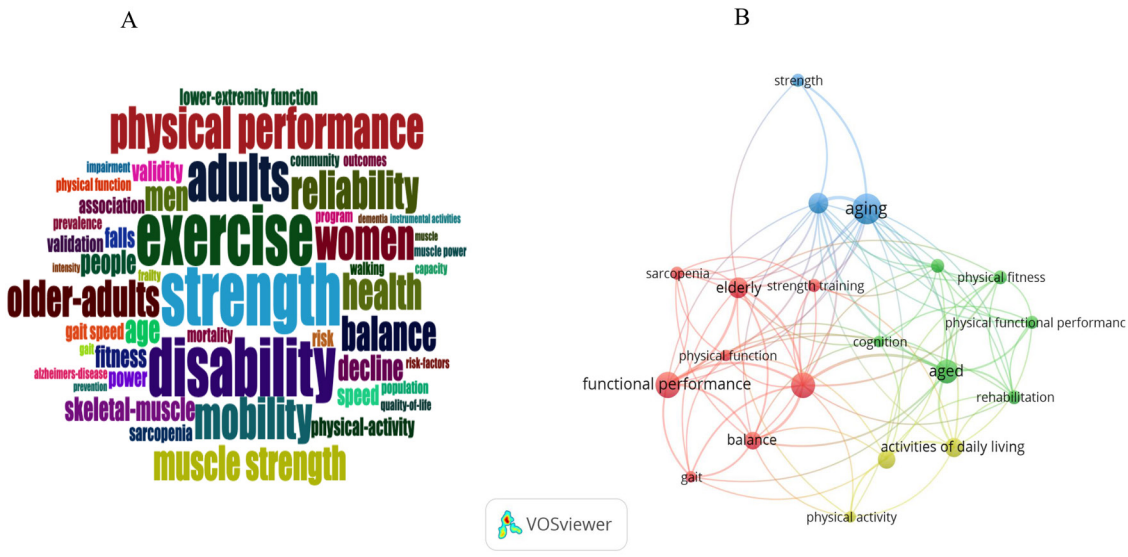

Figure 3. (A) Word cloud of keywords. (B) Co-occurrence of keywords.

and *Rehabilitation* is in second place in WoS categories on functional performance.

The most productive authors are Cress ME, Bezerra ES and Dias RC from the USA, and Brazil respectively. The findings of bibliometric analysis from a country perspective indicated that the most productive and relevant countries were Brazil and the USA. The authors most relevant to this field and their countries are complementary to these findings. In terms of institutes, the Federal University of Minas Gerais in Brazil has the highest number of publications. Citation of countries analysis showed the USA has the highest total link strength and followed by Brazil. In the light of these consistent findings, it is clear that Brazil and the USA have researchers and opportunities who are interested in this field in terms of publication, as leading countries. Although the USA was the most relevant country, only 5.13% of the publications were with multiple countries; and although Brazil was in the first rank, only 21.05% of publications were with multiple countries. Science can be an important component that connects different national innovation systems and enables growth through international knowledge flows (29). As an important part of rapidly changing research systems, international research collaboration is also recognized as an indicator of high quality research. International research collaboration provides opportunities for health researchers to share experiences, data and methods that can form the basis for new and important insights into current practice (30). Although international collaboration in science has increased rapidly in recent years (31), findings of this study indicate the need for international collaboration in this field.

The most highly cited papers were published in Q1/Q2-rated (quartile 1 and 2 – the top quarter based on ranking) journals according to the Journal Citation Reports. This can be explained by the fact that researchers have submitted their articles with a higher citation potential to higher-ranking journals. On the other hand, it is thought that factors related to good management of the publication process, such as some high-ranking journals keeping the publication process short, may be effective in revealing this result.

Keywords reflect the authors' focus, the trend of publications' research topics, with the most used keywords indicating the most researched topics (32). The analysis of keywords showed that the four cluster keywords focus on muscle strength and exercise areas in this study. The relationships between keywords make it easier to understand the key concepts and topics of a field. Through keywords, the focus areas of authors and publications can be assessed. The results of this analysis indicate that studies about functional performance in older adults are more related to muscle strength and exercise. The findings of keyword analysis are consistent with the most cited articles in this field. The top 3 most-cited articles were about aging, muscle strength, disability, and exercise.

The most cited study published by Hurley et al. (25) found that age-related deterioration in the sensorimotor function of the muscle may lead to increased fear and the frequency of falls in older people, thus decreasing independence. The findings indicate that combined exercise programs that increase muscle strength, postural stability, balance and proprioception should be implemented to reduce the fear, risk and frequency of falls and related trauma in older adults.

In addition, based on these findings, addressing many factors related to muscle function and functional independence of older people may be a reason why this study is the most cited publication. In addition, it is evident that studies investigating muscle function and its related factors have an important role for other studies about functional performance in older adults.

There are systematic review studies about functional performance in older adults in the literature (16-20). Eccentric exercise (17), high-velocity power training (HVPT) and traditional resistance training (TRT) (18), interventions were investigated in older adults. The functional performance was assessed with walking tests such as maximal walking speed, and timed up and go test, Short physical performance battery performance, stair climb test, chair stand time, sit to stand tests, and usual and fast gait speed tests (7,10,12). These studies showed eccentric exercise, resistance training improved functional performance (7,12), and the effectiveness of HVPT may be equivalent to TRT protocols in terms of functional performance in older adults (10).

However, there was no bibliometric analysis study in this field worldwide. Bibliometric analysis studies differ from systematic reviews, but are complementary, as they consider the research from a holistic perspective and map the general knowledge. It is recommended that some of the sub-topics highlighted in this study be analyzed more deeply through a systematic review in future studies.

Strength and Limitations

Being the first bibliometric analysis study which was analyzed with Biblioshiny-R and VOSviewer on functional performance in geriatric individuals is the main strength of this study. This study has a more comprehensive perspective and important data for sources, authors, countries, documents, words than studies in the literature. The co-occurrence cluster and network analysis provide information in terms of both the number of times that the terms co-occurred and knowledge about the relationships between the terms.

The present study also has some limitations. The bibliometric analysis includes only English-language papers and articles document type in the WoS database. Research in other languages and document types were excluded in data collection.

The comprehensive findings of the WoS database point out that the number of publications about functional performance of geriatric individuals has decreased rapidly in recent years. Although the average citation rate increased rapidly after 1995 and reached its highest level in 1998, this rate has decreased and reached its initial level in recent years. The results suggest that, although the USA was the most relevant country, only 5.13% of the publications were with multiple countries. Brazil had the highest number of publications with multiple countries with only 21.05% of publications, indicating a significant lack of international collaboration. Future research should include analysis of scientific databases such as Scopus and PubMed.

CONCLUSION

In conclusion, the USA stands out as the most productive, cited and relevant country in this study. The Journal of the American Geriatrics Society, also published in the USA, was the most cited source. Cress ME from the USA was the most relevant author. Despite the USA being the most relevant country, only 5.13% of publications were with more than one country, indicating a significant lack of international collaboration. This study, which shows there is a significant deficiency in international cooperation in terms of research on functional performance in the geriatric population, provides guidance to physiotherapist clinicians and researchers in terms of countries, authors and institutions that could potentially collaborate. In addition, the analysis of the most cited publications and keywords can shed light on the idea and design of physical and functional performance studies.

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REFERENCES

1. Bonder BR, Dal Bello-Haas V. Functional performance in older adults. 4th ed. Philadelphia: FA Davis; 2017.
2. Crandall KJ, Steenbergen KI. Older adults' functional performance and health knowledge after a combination exercise, health education, and bingo game. Gerontol Geriatr Med. 2015;1:2333721415613201.
3. Singh AS, Chin A Paw MJ, Bosscher RJ, van Mechelen W. Cross-sectional relationship between physical fitness components and functional performance in older persons living in long-term care facilities. BMC Geriatr. 2006;6:4.
4. Schaun GZ, Bamman MM, Alberton CL. High-velocity resistance training as a tool to improve functional performance and muscle power in older adults. Exp Gerontol. 2021;156:111593.
5. Martínez-Hernández BM, Rosas-Carrasco O, López-Teros M, González-Rocha A, Muñoz-Aguirre P, Palazuelos-González R, et al. Association

between physical activity and physical and functional performance in non-institutionalized Mexican older adults: a cohort study. BMC Geriatr. 2022;22(1):388.

6. Leme DEC, Alves EVC, Lemos VCO, Fattori A. Network analysis: a multivariate statistical approach for health science research. Geriatr Gerontol Aging. 2020;14(1):43-51.
7. Moral-Muñoz JA, Herrera-Viedma E, Santisteban-Espejo A, Cobo MJ. Software tools for conducting bibliometric analysis in science: An up-to-date review. Profesional de la Información. 2020;29(1):e290103.
8. Tsay MY, Yang YH. Bibliometric analysis of the literature of randomized controlled trials. J Med Libr Assoc. 2005;93(4):450-8.
9. Öztürk ÇP, Baskurt F, Baskurt Z. Bibliometric analysis of publications in the field of physiotherapy in Türkiye. Turk J Physiother Rehabil. 2025;36(1):114-32.
10. Ansari MA, Gul S, Yaseen M. Alzhemier's disease: a bibliometric study. TRIM. 2006;2(2):130-40.
11. Asghar I, Cang S, Yu H. Assistive technology for people with dementia: an overview and bibliometric study. Health Info Libr J. 2017;34(1):5-19.
12. Hao Y, Li B, Huber SA, Liu W. Bibliometric analysis of trends in cardiac aging research over the past 20 years. Medicine (Baltimore). 2023;102(34):e34870.
13. Müller AM, Ansari P, Ebrahim NA, Khoo S. Physical activity and aging research: a bibliometric analysis. J Aging Phys Act. 2016;24(3):476-83.
14. Shen CW, Nguyen DT, Hsu PY. Bibliometric networks and analytics on gerontology research. Library Hi Tech. 2019;37(1):88-100.
15. Xiang Q, Hu Y, Zheng J, Liu W, Tao J. Research hotspots and trends of exercise for sarcopenia: a bibliometric analysis. Front Public Health. 2023;11:1106458.
16. Guadagnin EC, Barbieri FA, Simieli L, Carpes FP. Is muscular and functional performance related to gait symmetry in older adults: A systematic review. Arch Gerontol Geriatr. 2019;84:103899.
17. Kulkarni D, Gregory S, Evans M. Effectiveness of eccentric-biased exercise interventions in reducing the incidence of falls and improving functional performance in older adults: a systematic review. Eur Geriatr Med. 2022;13(2):367-80.
18. Morrison RT, Taylor S, Buckley J, Twist C, Kite C. High-velocity power training has similar effects to traditional resistance training for functional performance in older adults: a systematic review. J Physiother. 2023;69(3):148-59.
19. Nagata CA, Garcia PA, Hamu TCDDS, Caetano MBD, Costa RR, Leal JC, et al. Are dose-response relationships of resistance training reliable to improve functional performance in frail and pre-frail older adults? A systematic review with meta-analysis and meta-regression of randomized controlled trials. Ageing Res Rev. 2023;91:102079.
20. van Dijk M, Vreven J, Deschodt M, Verheyden G, Tournoy J, Flamaing J. Can in-hospital or post discharge caregiver involvement increase functional performance of older patients? A systematic review. BMC Geriatr. 2020;20(1):362.
21. Falagas ME, Pitsouni EI, Malietzis GA, Pappas G. Comparison of PubMed, Scopus, Web of Science, and Google Scholar: strengths and weaknesses. FASEB J. 2008;22(2):338-42.
22. Aria M, Cuccurullo C. bibliometrix: An R-tool for comprehensive science mapping analysis. Journal of Informetrics. 2017;11(4):959-75.
23. van Eck NJ, Waltman L. Software survey: VOSviewer, a computer program for bibliometric mapping. Scientometrics. 2010;84(2):523-38.
24. Hirsch JE. An index to quantify an individual's scientific research output. Proc Natl Acad Sci U S A. 2005;102(46):16569-72.
25. Hurley MV, Rees J, Newham DJ. Quadriceps function, proprioceptive acuity and functional performance in healthy young, middle-aged and elderly subjects. Age Ageing. 1998;27(1):55-62.
26. Small H. Co-citation in the scientific literature: a new measure of the relationship between two documents. J Am Soc Inf. 1973;24(4):265-9.
27. de Fátima Ribeiro Silva C, Ohara DG, Matos AP, Pinto ACPN, Pegorari MS. Short physical performance battery as a measure of physical performance and mortality predictor in older adults: a comprehensive literature review. Int J Environ Res Public Health. 2021;18(20):10612.
28. Beck Jepsen D, Robinson K, Ogliari G, Montero-Odasso M, Kamkar N, Ryg J, et al. Predicting falls in older adults: an umbrella review of instruments assessing gait, balance, and functional mobility. BMC Geriatr. 2020;22(1):615.
29. Ribeiro LC, Rapini MS, Silva LA, Albuquerque EM. Growth patterns of the network of international collaboration in science. Scientometrics. 2018;114:159-79.
30. Freshwater D, Sherwood G, Drury V. International research collaboration: Issues, benefits and challenges of the global network. Journal of Research in Nursing. 2006;11(4):295-303.
31. Leydesdorff L, Wagner C, Park HW, Adams J. International collaboration in science: The global map and the network. Arxiv. 2013.
32. Schuurman B. Topics in terrorism research: reviewing trends and gaps, 2007-2016. Critical Studies on Terrorism. 2019;12(3):463-80.

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THE COMPONENTS, PARAMETERS AND OUTCOMES OF CORE STABILITY TRAINING FOR LOWER EXTREMITY DYSFUNCTIONS: A SYSTEMATIC REVIEW OF EXPERIMENTAL TRIALS

ABSTRACT

Purpose: Core stability exercises, widely used for treating low back pain has recently been reported to rehabilitate lower extremity dysfunctions. However, information on the components and parameters of the exercise remains scarce. Hence, the aim of this systematic review was to synthesize evidence on core stability training for lower limb dysfunctions and determine the key components, parameters, and impact of the exercises.

Methods: A systematic search of electronic databases (PubMed, Scopus, ScienceDirect, Ovid, Cochrane, and Google Scholar) was carried out covering the period from January 2000 to March 2024. Articles were screened based on predefined criteria and their quality was assessed by using PEDro scale. Relevant data on the components, parameters, and outcomes of core stability exercise, were extracted and descriptively synthesized.

Results: Out of 2393 articles identified, seven articles met the criteria. Five trials administered exercise programme containing both isometric and isotonic exercises, with curl ups, bridges, quadruped stance and transverse abdominis contraction being the most frequent exercise routines. Most of the studies used isometric exercise with 5-second hold and 6-8 repetitions for each movement while for isotonic exercises most studies used 10 repetitions of 2-3 sets per movement. Significant reduction in pain and improvement in muscle strength, mobility, balance, foot posture and joint stability were reported.

Conclusion: Core stability training shows encouraging outcomes in improving lower limb dysfunctions in nonathletic individuals by enhancing lumbopelvic control. However, due to heterogeneity in studies further research is needed to establish the most effective components and their impact on various lower limb outcomes.

Keywords: Core stability, Exercise therapy, Lower extremity, Postural balance, Proprioception

ALT EKSTREMİTE DİSFONKSİYONLARI İÇİN ÇEKİRDEK STABİLİTE EĞİTİMİNİN BİLEŞENLERİ, PARAMETRELERİ VE SONUÇLARI: DENEYSEL DENEMELERİN SİSTEMATİK BİR İNCELEMESİ

ÖZ

Amaç: Bel ağrısının tedavisinde yaygın olarak kullanılan çekirdek stabilite egzersizlerinin, son zamanlarda alt ekstremite disfonksiyonlarının rehabilitasyonunda etkili olduğu bildirilmiştir. Ancak, egzersizin bileşenleri ve parametreleri hakkında bilgi eksiktir. Bu nedenle, bu sistematik derlemenin amacı, alt ekstremite fonksiyon bozuklukları için çekirdek stabilite eğitimi üzerine kanıtları sentezlemek ve egzersizlerin ana bileşenlerini, parametrelerini ve etkilerini belirlemektir.

Yöntem: Ocak 2000 ile Mart 2024 tarihleri arasında PubMed, Scopus, ScienceDirect, Ovid, Cochrane ve Google Scholar veri tabanlarında sistematik bir arama gerçekleştirilmiştir. Makaleler önceden tanımlanmış kriterlere göre taranmış ve kaliteleri PEDro ölçeği kullanılarak değerlendirilmiştir. Çekirdek stabilizasyon egzersizinin bileşenleri, parametreleri ve sonuçlarına ilişkin veriler çıkarılmış ve betimsel olarak sentezlenmiştir.

Bulgular: Tespit edilen 2393 makaleden yedisi kriterleri karşıladı. Beş çalışma hem izometrik hem de izotonik egzersizler içeren egzersiz programı uyguladı; mekikler, köprüler, dört ayak duruşu ve transversus abdominis kasılması en sık kullanılan egzersiz rutinleriydi. Çalışmaların çoğu, her hareket için 5 saniyelik tutuş ve 6-8 tekrar ile izometrik egzersiz kullandı; izotonik egzersizler için ise çoğu çalışma her hareket için 2-3 setten 10 tekrar kullandı. Ağrıda anlamlı azalma ve kas gücü, hareketlilik, denge, ayak postürü ve eklem stabilitesinde iyileşme bildirildi.

Sonuç: Çekirdek stabilite eğitimi, lumbopelvik kontrolü geliştirerek atletik olmayan bireylerde alt ekstremite fonksiyon bozukluklarını iyileştirmede umut verici sonuçlar göstermektedir. Ancak, çalışmalardaki heterojenite nedeniyle, en etkili bileşenlerin ve bunların çeşitli alt ekstremite sonuçlarındaki etkilerinin belirlenmesi için daha fazla araştırmaya ihtiyaç vardır.

Anahtar Kelimeler: Çekirdek stabilizasyonu, Egzersiz terapisi, Alt ekstremite, Postural denge, Propriosepsiyon

INTRODUCTION

Core stability training has been considered as one of the fundamental components in musculoskeletal rehabilitation. It has been widely utilized as a therapeutic exercise modality in the management of low back pain (LBP) (1). However, recent studies revealed a significant connection between core stability and lower limb outcomes, suggesting that core stability may contribute to lower limb function and performance (2-4). To elucidate the mechanism underlying the relationship between core stability and lower limb function, a comprehensive understanding of the anatomical framework of the core muscles is essential. In addition, appreciating the impact of core stability on lower limb functions requires a thorough grasp of muscles, joints, and neural control interactions that regulate trunk stability and movement. This complex interaction is critical to human movement and function, and it has spawned various propositions that warrant careful consideration (5).

The primitive concept of core stability emphasized that core stability requires the functional integration of three subsystems which are the passive spinal column, the active spinal muscles and the neural control unit. These subsystems allow an individual to maintain the intervertebral neutral zones within physiologic limits while performing activities of daily living (ADL) (6). Based on this concept, the core muscles are described as a muscular box-shaped or core, which comprises of abdominal muscles at the front, paraspinal muscles and gluteal muscles at the back, diaphragm muscle at the roof and pelvic floor muscles as the bottom of core (7,8).

Several studies investigated the mechanism of these integrating subsystems in relation to upper and lower limb performances and revealed that the torso, upper limbs, and lower limbs are interconnected as kinetic chains (5,9,10). In any athletic activity or spatial movement, there is synchronized activation of core muscles and limbs to ensure that the limbs are optimally positioned and moving at the appropriate velocity to accomplish the task (5,9). In this perspective, the core muscles were described as all anatomical structures between the sternum to the knee with the abdominal region as the centre of the core. Several studies concluded that shoulder and pelvic muscles should also be included in the core musculature because these muscles assist in transferring the energy from the centre of core to the extremities during everyday tasks (5,10).

Additional evidence explained that the trunk muscles, particularly the deep abdominal muscles, transverse abdominis and multifidus, activate significantly earlier than the lower limb muscles (11). This suggests that the core muscles play a crucial role in establishing a stable foundation before the onset of lower limb movements and forming an excellent solid base for efficient and effective motion (11). Such findings changed the dimensions of the understanding of core stability function whereby the core muscles are reported to have a unique capability to manage the position and movement of the trunk relative to the pelvis and legs which enables the distal limbs to achieve optimal and controlled motion within the connected kinetic chains. This mechanism leverages the stability provided by the core muscles to generate efficient and effective movement patterns (5).

The relationship between core musculature and lower limb mechanics is critical, as core stability deficits can lead to mechanics alteration to the lower limbs and an increased risk of lower limb injuries. For instance, previous studies have shown that the knee pathologies can negatively influence core stability, leading to decreased abduction and external rotation forces, which in turn result in increased knee adduction and internal rotation (12-14). Such alteration subsequently raises the patellofemoral joint reaction forces, contributing to pain and dysfunction (12). Additionally, core stability deficits have been found among individuals with ankle injuries, such as flat feet and ankle sprains (13-15). This makes it evident that core muscles have an effect on lower limbs from the hips to the ankles and strengthening the core, therefore is essential in the prevention and rehabilitation of these injuries, as it may improve overall faulty mechanics, reduce pain, and enhance function.

While several studies have revealed the effects of core stability exercises on speed, balance, strength and performance in the athletic population, (16-20), such prescription of exercises may not be applicable to non-athletes due to the differences in definition. Athletes are engaged in regular competitive training with the primary goal of improving performance and outcomes, while non-athletes participate in physical activity mainly for health, fitness, or leisure purposes. These distinctions suggest that the training intensity, frequency, and objectives differ markedly between these two groups, which could influence the applicability of findings from athletic studies to nonathletic populations (21). Therefore, a systematic review of core stability exercise prescription for nonathletic individuals with lower limb dysfunctions is necessary.

Despite the growing number of studies reporting intervention and exercise parameters have proliferated (22-25), yet none have addressed core stability training. Such a study is highly needed because health practitioners require evidence-based recommendations when formulating an effective plan of care. Hence this comprehensive review was designed to identify the key components, parameters and effects of core stability exercises specifically required for lower limb dysfunctions among nonathletic subjects.

METHOD

Study Protocol

The protocol of this systematic review was registered in the PROSPERO database (registration number: CRD42023491502) and adhered to the PRISMA statement guidelines (26). A specific framework (Table 1) known as the PICOS framework (Population, Intervention, Comparison, Outcome, Study design), was utilized to formulate the following research questions (27).

a. What are the components and parameters of core stability training used in lower extremity dysfunctions?

b. Does core stability training have positive effects on lower extremity dysfunctions?

Eligibility Criteria

Studies were included if they met the following conditions:

Published in English, peer-reviewed, and available in full text.

Published between January 2000 and March 2024.

Included nonathletic participants aged 18 years or older with lower limb dysfunctions as protocols for athletes differ in volume, intensity and specificity to those of nonathletic individuals.

Core stability training was the principal intervention, even if additional lower limb exercises were included as part of control routines or supplementary interventions.

Reported outcomes related to lower extremity function.

Studies were excluded if they:

Involved subjects without lower limb dysfunction, even if core stability exercises were used to address other conditions, such as LBP.

Involved exercises that primarily focused on proprioception training, neuromuscular training, or other interventions and did not explicitly aim to strengthen or stabilize the core musculature as the main component.

Table 1. PICOS framework for systematic review

Components	Descriptions
Population	Non athletic participants aged ≥18 years with lower extremity dysfunctions.
Intervention	Exercises targeting core muscles (spinal stabilization exercise).
Control	Any comparative or controlled treatment.
Outcome	Any outcome assessing improvements in discomfort or function of lower extremities.
Study design	All types of experimental studies

Were case control studies.

Were other non-experimental designs such as commentaries and case reports, reviews and meta-analyses.

Included athletic participants.

Included subjects who underwent surgical treatment of their disorder (e.g. surgical reconstructions of soft tissue structures, arthroplasty etc.) to ensure that the effects observed are solely attributable to core stability exercises rather than confounded by post-surgical recovery processes.

Involved participants less than 18 years of age to ensure findings are applicable to adult population.

Lacked sufficient protocol details.

Included participants with neurological disorders like stroke and spinal pathologies.

Search Strategy

A robust systematic electronic search was conducted by Assessor 1 (S.M.D.) in PubMed, Scopus, Cochrane, Ovid, and Science Direct. In addition, Google Scholar was used as a secondary database in the search strategy. During the search process, the combination of text words and medical subject headings (MeSH) with Boolean operators used were: (Core stability OR Postural balance OR segmental stability) AND (Exercises OR Training) AND (Muscle endurance OR Muscle strength) AND (Lower extremity OR Knee OR Foot) AND (Dysfunctions OR Disorders). Our search strategy focused on core stability as the principal intervention. While lumbopelvic stability is inherently related to core stability, it was not included as an independent search term. The closest MeSH terms available were Posture and Muscle Strength, which were incorporated to ensure relevant studies were captured.

Study Selection

Articles were identified through an initial web search and imported into Mendeley and screened for duplicates by Assessor 1 (S.M.D.) After duplicates removal, S.M.D. performed the title and abstract screening. Finally full texts of the remaining studies were retrieved. The folder of full text articles was shared via Mendeley library with Assessor 2 (S.S.K.), who along with S.M.D. independently reviewed the full-text articles for eligibility, ensuring an unbiased assessment.

Studies that did not meet the inclusion criteria were excluded, with reasons for exclusion systematically documented.

To assess inter-rater agreement between the assessors the percentage agreement was recorded before the discussion. A 3rd Assessor (E.E.K.) was involved in panel discussion to resolve

discrepancies between first two assessors based on predefined eligibility criteria, leading to a final selection of studies.

Quality Assessment

The methodological quality of each included article was critically appraised using the PEDro scale by two independent assessors (S.M.D. and S.S.K.). Any disagreements were recorded before discussion, with percentage agreement calculated for the 7 selected studies. Differences were resolved through discussion with a E.E.K. until consensus was reached (28). The PEDro scale evaluates the validity of studies based on 10 criterias including random allocation, concealed allocation, baseline comparability, blinding of subjects and assessors, adequate follow-up, intention-to-treat analysis, and point estimates with variability. Each article was rated on each criterion, resulting in a maximum total score of 10. The quality of the articles was then categorised as poor (0-3), fair (4-5), good (6-8), or excellent (9-10). This assessment ensured that the studies included in the systematic review were critically evaluated for their methodological quality, providing a robust basis for the synthesis of evidence (29).

Data Extraction

The characteristics of each study comprising of lead author, year of publication, number of participants, mean age of the participants, participants characteristics, and outcome measurements used in the study were presented in a customized data extraction form. Data relating to the components, parameters and outcomes of core stability training were manually extracted and collected. Exercise components and parameters were collected based on specific categories as outlined in previous studies (22-25), whereby the term "component" is referred to the type and routine of the exercise, while "parameter" is the dosage of exercise (number of sessions per week, number of repetitions and sets, duration of exercise programme, overall length of the exercise programme and exercise progression as well as the mode of exercise application). Furthermore, a subgroup analysis for most frequent core stability exercise routines, type of exercises (isometric or isotonic), duration of treatment (more than 6 weeks or less than 6 weeks) and outcome measures (pain, balance, and functional performance) was performed to enhance clarity. The data was initially extracted by two researchers (S.M.D. and S.S.K.) and subsequently cross-checked and verified by other researchers [E.E.K., Assessor 4 (N.A.A.R.) and Assessor 5 (M.J.)].

RESULTS

A systematic search across various databases yielded a total of 2,392 articles, including 165 from PubMed, 97 from Scopus, 26 from ScienceDirect, 1,003 from Cochrane, 52 from Ovid and 1,049 from Google Scholar. After removing 178 duplicate records using Mendeley, 2,214 unique studies remained for screening. Following title and abstract screening, 2,068 articles were excluded, based on the exclusion criteria, to make sure that included studies involved: subjects without lower limb dysfunction, non-core stability interventions, non-experimental study designs (such as reviews and case reports), athletic participants, juvenile populations, subjects with neurological disorders, and irrelevant studies, leaving 146 articles for further evaluation. Of these, only 101 full-text articles were successfully retrieved and further assessed for eligibility. During this stage, 94 were excluded for various reasons as outlined in Figure 1. Independent analysis of 101 articles by S.M.D. and S.S.K. revealed a 60.87% agreement before discussion, reflecting initial differences in study selection, with S.M.D. selecting 14 articles and S.S.K. selecting 9 articles. Following discussion and analysis with support from E.E.K., ultimately 7 articles met the predefined criteria and were included in the final review. This process is summarized in Figure 1, a PRISMA flow diagram depicting the selection of articles.

Study Characteristics

The characteristics of the included studies were extracted and tabulated in Table 2. The total sample size of the included studies was 237, which included 120 subjects in interventional group and 117 subjects in the control group (30-36). The mean age of the subjects across the seven trials was varying, with the minimum mean age reported as 21 years (33) and the maximum as 56 years (30). All studies were published from 2016 onwards and employed a two- group design, where the experimental groups received core stability exercises as an interventional treatment, while the control groups received conventional exercises as a controlled treatment. This design enabled the studies to compare the effects of core stability exercises to conventional exercises on the outcomes of interest. All studies examined core stability training on various lower extremity conditions, three studies investigated its impact on patellofemoral joint dysfunctions (32,33,35), while one study each explored its effects on knee osteoarthritis (30), mild lower limb discomfort (31), flat feet (34), and anterior cruciate ligament injury (36).

The seven studies employed various tools to assess the outcomes. Balance was evaluated using outcome measures such as the Biodex Balance System (30), Y balance test (31), and star excursion balance test (35). Pain was measured with Visual Analog Scale (VAS) (30-33), Numerical Pain Rating Scale (NPRS) (32) and Kujala Patella-Femoral Scale (AKPS) (35). Functional independence and ADL were assessed using the Knee Injury and Osteoarthritis Outcome Score (KOOS) (30,32) and Lysholm Knee Scale (36). Physical performance was measured with the Timed Up and Go (TUG) test (32). Strength of lower limb muscles was assessed using a handheld dynamometer (31,32) and the

Biodex System (36). Foot posture was evaluated using the Foot Posture Index (FPI) (35) and weight distribution with fore foot load response were also measured (34).

Methodological Quality

The percentage of agreement before the discussion between the two reviewers was 71.43%. with assessors showing agreement on 5 out of 7 seven studies. Quality score of remaining 2 studies were discussed and analysed by 2 assessors with inputs from 3rd Reviewer. Finally, the disagreements were sorted for both the studies. Based on the final PEDro scale assessment, the total scores ranged from 4 to 8 out of 10, indicating moderate to high quality. All studies clearly defined eligibility criteria, with most studies employing random allocation and baseline compatibility. However, a significant weakness across all studies was that the lack of blinding of subjects and

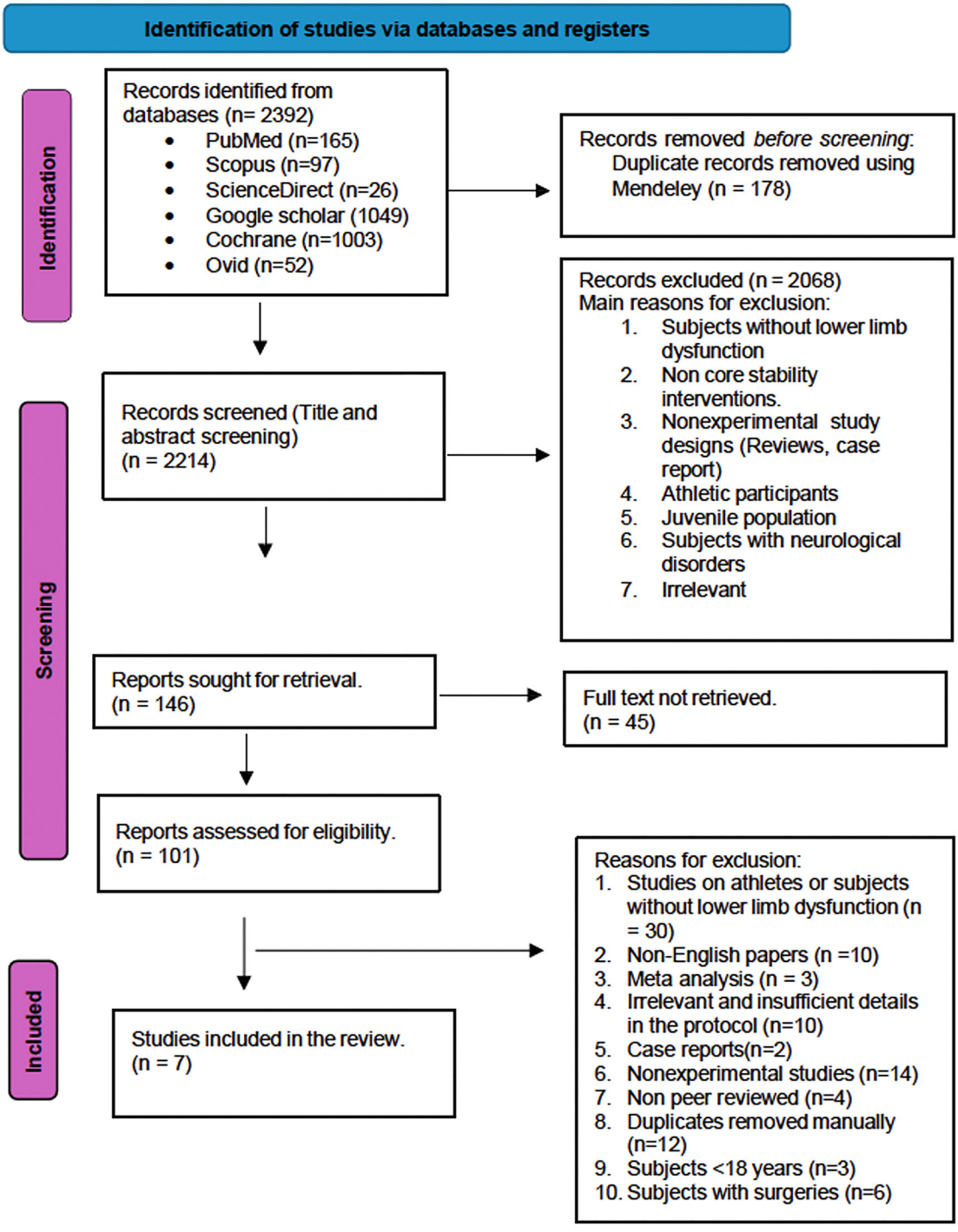

Figure 1. Prisma flow diagram depicting selection of articles (26).

therapists, which could introduce bias. While some studies ensured blinding of assessors (31,35), others did not, further impacting the reliability of the results. Follow-up adequacy was generally well-reported, with minimal dropouts noted in several studies (32-36). Intention-to-treat analysis and between-group comparisons were consistently addressed in all studies, enhancing the robustness of findings. Table 3 provides detailed information on the methodological quality of each study.

Components and Parameters of Core Stability Training for Lower Limb Dysfunctions

This review discovered some commonalities across the seven studies. First, based on the interventional core exercise routines outlined in Table 4, most of the studies had activated the global core muscles (erector spinae, quadratus lumborum, obliques, and rectus abdominis) instead of merely focussing on local/deep

Table 2. Characteristics of selected studies

No.	Author (year)	Patient's characteristics	No. of subjects per group with mean age	Interventions in each group	Outcome measure tools
1.	Lam et al. 2023 (30)	Knee osteoarthritis patients	EG: 10 (56.40±8.87 y.o.) CG: 10 (55.90±7.74 y.o.)	EG: Core stability exercises with conventional exercises (lower limb strengthening and stretching exercises). CG: Conventional exercises (lower limb strengthening and stretching).	VAS - pain, Biodex balance - balance, KOOS - functional independence.
2.	Kim et al. 2020 (31)	Patients with mild lower limb discomfort	EG:10 (32.2±9.9 y.o.) CG: 10 (25.50±5.70 y.o.)	EG: Core stability exercises. CG: Maintain usual lifestyle.	VAS - pain and discomfort, FMS test - physical performance YBT kit - balance, Handheld dynamometer - strength of lower limb muscles.
3.	Hoglund et al. 2018 (32)	Patello-femoral osteoarthritis patients	EG: 10 [50 (46.56) y.o] CG: 10 [52 (49.56) y.o.]	EG: Core stability exercises and hip strengthening exercises. CG: No treatment.	NPRS - pain, KOOS - ADL, TUG - physical performance. Dynamometer - strength of hip and knee musculature.
4	Chevidikunnan et al. 2016 (33)	Patients with patellofemoral pain syndrome	EG: 10 (21.4±1.8 y.o.) CG: 10 (22.2±1.3 y.o.)	EG: Core stability exercises with conventional lower limb strengthening exercises. CG: Conventional lower limb strengthening exercises.	VAS - pain symptoms, SEBT - balance.
5	Pachava et al. 2022 (34)	Flat feet patients	EG: 13 (23.38±1.32 y.o.) CG: 13 (24.15±1.28 y.o.)	EG: Core stability exercises. CG: Foot intrinsic exercises.	FPI-6 - foot posture. Weight distribution %, foot load response was also used.
6	Tazesh et al. 2022 (35)	Patients with patellofemoral pain	EG: 35 (32.1±6.0 y.o.) CG: 35 (32.5±5.9 y.o.)	EG: Core strengthening exercises with routine exercises (lower limbs strengthening and stretching exercises). CG: Routine exercises (lower limbs strengthening and stretching exercises).	VAS - pain. Kujala patella - femoral scale (AKPS) - pain and functional status.
7	Çelik et al. 2017 (36)	Patients with anterior cruciate ligament injuries	EG: 32 (25.0 ± 9.1 y.o.) CG: 29 (25.9 ± 7.5 y.o.)	EG: Pilates exercises with core strengthening exercises. CG: Pilates exercises after week 12.	Lysholm Knee Scale & Cincinnati Knee Rating System – lower limb functions Biodex system – lower limb strength.

AKPS: Anterior Knee Pain Scale, CG: Control Group, EG: Experimental Group, FMS: Functional Movement Screen, FPI: Foot Posture Index, KOOS: Knee Injury and Osteoarthritis Outcome Score, No.: Number, SEBT: Star Excursion Balance Test, TUG: Timed Up and Go test, VAS: Visual Analog Scale, y.o.: Years old, YBT: Y-Balance Test.

Table 3. Methodological quality (PEDro Scale)

Study	1	2	3	4	5	6	7	8	9	10	11	Score
Lam et al. 2023 (30)	√	√	√	√	×	×	×	×	√	√	√	6
Kim et al. 2020 (31)	√	√	×	√	×	×	√	×	√	√	√	6
Hoglund et al. 2018 (32)	√	×	×	√	×	×	×	×	√	√	√	4
Chevidikunnan et al. 2016 (33)	√	√	√	√	×	×	×	√	√	√	√	7
Pachava et al. 2022 (34)	√	√	×	√	×	×	×	√	√	√	√	6
Tazesh et al. 2022 (35)	√	√	√	√	×	×	√	√	√	√	√	8
Çelik et al. 2017 (36)	√	√	√	√	×	×	√	√	√	√	√	8

1: Eligibility criteria, 2: Random allocations 3: Concealed allocation, 4: Comparability at baseline, 5: Patient blinding, 6: Therapist blinding, 7: Assessor blinding, 8: At least 85% follow-up, 9: Intention to treat analysis, 10: Between-group statistical comparisons, 11: Point measures and measures of variability. Item 1 not counted in PEDro Score.

core muscles (transverses abdominis and multifidus). Second, the activation of core muscles was performed through specific activities that mimic daily and sport-specific movements.

In this review, it was observed that core exercise protocols incorporating both isometric and isotonic muscle actions were the most adopted, with five out of seven included studies utilizing a combination of both in their intervention programmes (31,32,34-36). One trial adopted isometric exercises only (30) while one adopted isotonic exercises (33). Most of the exercise programmes were professionally supervised through a combination of face-to-face sessions and telecommunication interaction, with home exercise programme prescribed to supplement the supervised sessions (31,32,35,36).

The core stability exercises were employed with a broad range of interventional exercise manoeuvres. One study included exercises such as back bridges, unilateral bridges, and curl-ups (30), while another utilized a range of exercises including curl ups, crisscross, double leg lowering, scissors, shoulder bridges, quadruped stance, Sperman exercise and various core stability movements (31). Another study focused on the activation of the transversus abdominis (TA) muscle in conjunction with pelvic musculature strengthening exercises, emphasizing the coordinated engagement of the TA during training (32). Another study focused on cross curl-ups, side bridges, and quadrupedal stance (33), and yet another implemented a comprehensive set of exercises, including bridges with leg lifts, various plank variations, static curl ups, bicycles, vertical crunches, and trunk rotations (34). Additionally, one study incorporated exercises like lateral walks, abdominal drawing in (TA activation), sidekicks, Quadruped stance, and exercises targeting pelvic musculature especially gluteal muscles (35) and another used diverse set of exercises, such as heel slides, shoulder bridges, heels together toe apart side circles, and swimming (36). The detailed list of exercises used in each study is outlined in Table 4.

To determine the most preferred exercises in core stability programs, a frequency table was formulated. Each exercise routine, along with any variations, was rated in percentages, based on the number of studies that included them, providing a clearer understanding of the most used and preferred exercises in core stability training (Table 5). According to this analysis, exercises, bridges and its variations were the most frequently used (71.42%), followed by curl-ups and quadruped stance with its variations (57.15% each). Transverse abdominis isometric contraction was 3rd most common and preferred exercises (43%), followed by Sperman exercise, transverse abdominis muscle activation, bicycles, double leg lowering and hip musculature strengthening (28.57% each). The details of their frequency are reported in Table 5.

The parameters of core strengthening exercises across the seven trials illustrated in Table 4, depended on the type of exercises. Out of seven, only five trials reported the exercise frequency. As for isometric exercise, 5 seconds hold was commonly prescribed for each exercise (30-32), with 8 repetitions for 2 sets of each exercise (31,32). For isotonic exercises, 10 repetitions of 2- 3 sets for each exercise was frequently pronounced (31-33). In half of the studies exercise programmes were considered as a progressive training as the complexity of the exercises were increased throughout the weeks (32,33,35,36). The total number of treatment sessions varied across the studies, ranging from 10 to 60 sessions. The frequency of interventions weekly also differed, with most of the studies conducting treatment sessions 3 times weekly (30,31,33,36). One study reported frequency interventions 2 times weekly (32); another study reported 6 sessions weekly (34) and one trial conducted 5 sessions weekly (35). Additionally, the duration of the interventions also showed variations, with interventions in three studies lasting for 4 weeks (31,33,34); two studies providing intervention for 6 weeks (30,32); and another two studies applying intervention for 12 weeks (35,36).

The included studies featured a variety of exercise protocol delivery modes. One study administered their exercise protocols as home programs (30), while four studies used face-to- face delivery of intervention (31-34) and one study employed a mixed mode, with subjects starting each new stage of the exercise protocol face-to-face and continuing with

Table 4. Components, parameters and outcomes of core strength training

No.	Author (year)	Components		Parameters					Outcomes
		Types of exercises	Routines in the interventional core exercises	No. of repetitions and sets	No. of sessions	Length of intervention	Exercise progression	Mode of delivery	
1	Lam et al. 2023 (30)	Isometric	3 exercises: Back bridge, quadruped arm or leg lift and curl up	5 seconds hold of 8 repetitions with 2 sets for each exercise	3 sessions a week	6 weeks	Not specified	Remote supervision	Pain score (VAS) and function significantly improved within EG ($p<0.05$). No statistically significant intergroup difference in any of the outcomes ($p>0.05$)
2	Kim et al. 2020 (31)	Isometric and isotonic	8 exercises: Curl up (roll down and up), criss-cross, double leg lower (up and down), scissors, shoulder bridge, Sperman, cat position, mini-squat	Isometric: 5 seconds hold of 6 repetitions. Isotonic: 10 repetitions with 2 sets each	3 sessions a week	4 weeks	Not specified	Face to face and remote supervision	Ankle pain score significantly lowered in EG ($p<0.05$) and significant improvements in FMS score (hurdle step and trunk stability), balance and in EG ($p<0.05$). No significant improvements in lower limb muscle strength reported ($p>0.05$)
3	Hoglund et al. 2018 (32)	Isometric and isotonic	6 exercises: Prone TA isometric (stabilizer for biofeedback, prone gluteus maximus isometric with knee flexed, hooklying TA isometrics with alternate hip/knee flexion/extension, sidelying hip ER with feet together (clamshells), side lying hip abduction, single-leg stance	Isometric: 5 seconds hold of 8 repetitions for each exercise. Isotonic: 10 repetitions with 3 sets for each exercise	2 sessions a week	6 weeks	Yes. Change the routine to be more challenging by modifying the movement of the limbs	Face to face supervision	Significant improvements in pain and function at post intervention ($p<0.05$). Enhanced physical performance in mobility ($p<0.05$) was also reported
4	Chevidikunnan et al. 2016 (33)	Isotonic	3 exercises: Cross curl up, side bridge, quadrupedal stance	20 repetitions for each exercise	3 sessions a week	4 weeks	Yes. Increase number of repetitions after week 2	Face to face supervision	Significant improvement for pain and balance reported in EG ($p<0.05$)

Table 4. Continued

No.	Author (year)	Components		Parameters					Outcomes
		Types of exercises	Routines in the interventional core exercises	No. of repetitions and sets	No. of sessions	Length of intervention	Exercise progression	Mode of delivery	
5	Pachava et al. 2022 (34)	Isometric and isotonic	10 exercises: Bridges with leg lifts, static abs, lower trunk rotation, planks (prone, left, right), bicycles, full vertical crunches, bridges with marching, long arm crunches, trunk rotation with weights, bilateral leg lowering	Isometric: 10-20 seconds hold, 3 sets Isotonic: 5-15 repetitions with 1 set	6 sessions a week	4 weeks	Yes. Change the number of repetitions and sets for each exercise	Face to face supervision	Significant improvement in foot posture of both feet in EG ($p<0.05$) was reported. No improvements in weight distribution and foot load response ($p>0.05$)
6	Tazesh et al. 2022 (35)	Isometric and isotonic	6 exercises: Wall slide (45-degree knee flexion), straight leg raises to 60-degree (sitting), abdominal draw-in exercises, side-lying clamshells, quadruped arm/leg extensions, and side-lying straight-leg raises	Isometric: 20 seconds hold of 15 reps with 2 sets each. Isotonic: 15-20 repetitions with 2 sets each	5 sessions a week	12 weeks	Yes. Change the routine to be more challenging by modified the movement of the limbs	Face to face and remote supervision	Significant improvements in pain and function in EG ($p<0.05$)
7	Çelik et al. 2017 (34)	Isometric and isotonic	9 exercises in week 1: Heel slides, hundreds in supine crook lying, single. Leg heel, side circles, side kick in lying, shoulder bridges, heel together toes apart, parallel, and one leg circle	Isometric: Not reported. Isotonic: 3-4 seconds each repetition. Number of repetitions and sets are not reported	3 sessions a week	12 weeks	Yes. Increase number of repetitions every two weeks with some modification on the exercise routine	Face to face and remote supervised mode	Significant improvement in Lysholm score (knee function) ($p<0.001$), Quadriceps strength ($p<0.05$) was reported In EG (88%) reported improved knee stability compared to only 23% in the control group

EG: Experimental Group, ER: External Rotation, FMS: Functional Movement Screen, No.: Number, TA: Transversus Abdominis, VAS: Visual Analog Scale.

home exercises for the remaining sessions (35). Another study conducted face-to-face sessions for the first 6 weeks, followed by home exercises for the remaining 6 weeks (36).

Outcomes of Core Stability Training

The outcomes of the studies revealed notable improvements in various measures depending on the interventions (Table 4). Out of seven, four studies found statistically significant reduction in pain outcomes (31-33,35), two trials reported significant improvements in lower limb strength (31,36), three studies demonstrated positive impacts on functional independence (22,35,36), two studies reported significant outcomes in physical performance (31,32), two studies discovered significant differences in balance (31,33), one study showed positive findings on foot posture (35) and one study reported significant improvements in knee stability (36) after core stability training. Across the seven trials, the pain outcome was evaluated using subjective measures like VAS, KOOS and NPRS.

The Biodex Balance System, KOOS, TUG test, a dynamometer, the AKPS, Lysholm Knee Scale, and Cincinnati Knee Rating System were used to measure functional independence and physical performance. As for lower limb strength outcomes, the objective instruments used were a dynamometer and a Biodex isokinetic machine. The balance outcome was measured by the Biodex Balance System and Star Excursion Balance Test while foot posture was measured by the FPI-6.

Subgroup Analysis for Exercise Type, Duration, and Outcome Measures

To address the heterogeneity among the included studies in terms of exercise protocols, intervention duration, and outcome measures, a subgroup analysis was performed. This aimed to clarify whether variations in muscle contraction type, treatment duration, or specific outcomes influenced the effectiveness of core stability training for lower extremity dysfunctions. Detailed summary of subgroup analysis is reported in Table 6.

Exercise Type: Five trials used combination of isometric and isotonic exercises and reported improvements in all outcomes except weight distribution and foot load response (31,32,34-36).

Intervention Duration: Interventions lasting less than 6 weeks in three studies (31,33,34) reported positive outcomes in all outcomes while one study (34) reported improvements in foot posture and no changes in weight distribution and

Table 5. Most frequently employed core stability exercises across included studies

Exercise category	Variations or modifications used	Number of studies incorporating exercise (n)	Frequency among studies (%)	7
Bridges with all variations	Back bridges	n=1 (30)	14.28%	
	Unilateral bridges	n=1 (30)	14.28%	
	Shoulder bridges	n=2 (31, 34)	28.57%	71.5%
	Bridges with marching	n=1 (34)	14.28%	
Curl ups	-	n=4 (30, 31, 33, 34)		57.15%
Quadruped stance or birddog	Quadruped with arm leg raises	n=3 (30, 33, 35)	42.85%	
	Quadruped to trunk raise and lowering	n=1 (31)	14.28%	57.15%
Sperman exercises	-	n=2 (31, 36)		28.57%
Bicycles or crisscross	-	n=2 (31, 34)		28.57%
Double leg lowering	-	n=2 (31, 34)		28.57%
Side lying clamshells	-	n=2 (32, 35)		28.57%
Side lying straight leg raise or side kicks	-	n=2 (35, 36)		28.57%
Sigle leg stance	-	n=2 (32, 36)		28.57%
Transverse abdominins (TA) contraction	Isometric TA contraction Isometric contraction of TA with hip knee flexion and extension	n=2 (32, 35) n=1 (32)	28.57% 14.28%	43%
Side bridges	-	n=1 (33)		14.28%
Planks	-	n=1 (34)		14.28%
Vertical crunches	-	n=1 (35)		14.28%
Scissors	-	n=1 (31)		14.28%
Hundreds	-	n=1 (36)		14.28%
Mini squat	-	n=1 (31)		14.28%
Trunk rotation	Lower trunk rotation	n=1 (34)	14.28%	28.57%
	Trunk rotation with weights	n=1 (34)	14.28%	
Side circles	-	n=1 (36)		14.28%
Heels together toe apart	-	n= 1 (36)		14.28%
One leg circle	-	n=1 (36)		14.28%
Straight leg raise	-	n=1 (35)		14.28%
Wall slides	-	n=1 (35)		14.28%
Gluteal muscle isometrics	-	n=1 (32)		14.28%

foot load response. While exercise protocols lasted six or more than 6 weeks in four studies (30,32,35,36) with significant improvements in all outcomes except for one trial (30).

Outcome Measures: Five pain focussed studies (30-33,35) demonstrated significant pain relief except one (30). Three trials (30,31,33) assessed balance, with two studies demonstrating significant improvements (31,33). Four studies assessed subjects for functional independence (30,32,35,36) with all reporting positive improvements except one study (30). Two out of seven studies measured physical performance (31,32) and both reported significant improvements. Similarly, two studies (31,36) assessed lower limb muscle strength, and one study reported significant changes in strength (36). One study used foot posture, weight distribution and foot load response demonstrated significant outcomes in foot posture only (34). Only one study assessed knee stability and showed significant improvements (36).

DISCUSSION

To the best of authors' knowledge, this is the first systematic review which collected evidence of the components, parameters and outcomes of core stability exercise for lower limb dysfunctions. However, only seven (n=7) studies were selected finally, which is a small number, compared to the initial number of studies identified in web search (n=2392). This decrease in the number was primarily due to very strict exclusion criteria, where only studies using core stability training on subjects with musculoskeletal lower limb musculoskeletal disorders in nonathletic population and have not undergone any surgical procedures of the dysfunction were included. This purposeful exclusion was necessary because, protocols of core stability exercises for athletic population cannot be applicable to nonathletic participants, due to difference of fitness levels and to subjects undergone surgeries, because postoperative rehabilitation involves more cautious and modifies approach in the early stages of progress, which may be different from the standard core stability protocols. This led to the exclusion of maximum number of studies, maximum of which were mostly falling in either of these categories.

This review has two principal objectives, which are to identify the components and parameters of core stability rehabilitation program that can improve the outcomes of lower extremity functions and to investigate the effects of core muscle training on various outcomes among individuals suffering from lower extremity disorders.

Effect of Core Exercises on Lower Extremity Dysfunction

The effects of core stability training on lower extremity dysfunctions are evident after a thorough survey of literature, hence supporting the connection between core muscle strength and lower extremity functions as suggested by several studies (14,37). This review covered seven studies that investigated the effects of core muscle activation on lower extremity outcomes.

One study reported that participants in the core stability exercises group had shown similar outcomes in balance, pain score, and KOOS as compared to participants who had received routine rehabilitation exercise (30). Additionally, one study found no significant effect of core stability exercises on weight distribution and foot load response (34), while another did not observe any impact on lower limb strength (31). Despite these findings, remaining all studies demonstrated significant effects in various outcomes like pain, balance, functional independence, lower limb muscle strength, physical performance, foot posture, and knee stability (31-34).

To gain a clearer understanding, a subgroup analysis based on the types of outcome measures used, revealed that the most frequently assessed outcomes were pain, balance, and functional performance, whereas lower limb strength, physical performance, foot posture, knee stability, and weight distribution were less commonly evaluated. Most studies reported significant improvements in pain, balance, physical performance and function (31-33,35-36). Findings related to lower limb strength were mixed, with some studies showing improvement while others did not (31,36). Notably, foot posture and knee stability, each assessed in only one study showed positive outcomes (34,36). In contrast, weight distribution, also assessed in one study, showed no improvement (34). With most studies demonstrating positive results in these domains, suggesting that while core stability training generally contributes positively to lower limb function, the impact may vary depending on the specific domain assessed. Additionally, the heterogeneity in assessment tools used across studies limits direct comparisons but highlights the variety of functional improvements associated with core training.

Before drawing firm conclusions, the methodological quality of the included studies must be considered. None of the studies employed blinding of patients or therapists (30-36), and four lacked assessors blinding as well (30,32-34). Two studies did not implement concealed allocation during sampling (31,32), and one study lacked randomisation altogether (32). In three studies, fewer than 85% of participants completed the intervention (30-32). Additionally, three trials had short-term follow-up periods (31,33,34), while four had moderate-term follow- ups (30,32,35,36), leaving the long-term sustainability of improvements unclear. Five studies had small sample sizes ranging from 20 to 26 participants (30-34), with two of them being feasibility or pilot trials, whereas only two studies had larger samples (35,36). Finally, the considerable heterogeneity

in exercise protocols, participant characteristics, and outcome measures makes it difficult to draw generalizable conclusions regarding the efficacy of core stability training for lower limb dysfunctions.

Despite these methodological limitations, the overall findings of the included studies align with previous observational studies that have highlighted a link between core muscle function and lower limb pathologies (15,38,39). Additionally, several clinical trials conducted in athletic populations have reported significant improvements in lower limb performance following core stability training (16-20,40). However, caution is warranted when extrapolating these findings to nonathletic populations, as differences in baseline fitness levels, physical activity, and health status may influence outcomes. Thus, while supportive evidence exists, further high-quality research on diverse populations is needed to strengthen the generalizability of these findings.

Efficacy of core stability training on lower limb disorders has been increasingly explored recently due to its emphasis on enhancing lumbopelvic control and dynamic stability. Although studies on other rehabilitation strategies, such as neuromuscular training and strength training, have shown promising results in lower limb rehabilitation (41,42). The findings of this review highlight the specific and unique role of core stability training in addressing movement deficits and functional impairments associated with lower limb dysfunctions. Core stability training is particularly effective in improving lumbopelvic control, which is vital for proper lower limb movement patterns and overall functional performance (15).

While neuromuscular training enhances proprioceptive feedback and muscle recruitment, and strength training focuses on isolated muscle groups, core stability exercises target the deep stabilizing muscles essential for coordinated movement, by establishing a stable base for every lower limb movement (5,11).This integrated approach improves not only the individual muscle function but also the dynamic stability of the entire kinetic chain, which is crucial for reducing the risk of injury and improving performance in activities requiring complex motor skills (43,44).

Building on the earlier discussion, it can be assumed that the observed improvements in lower limb functions following core stability training may be attributed to the foundational role of the core within the kinetic chain. Activation of the core muscles, particularly those responsible for lumbopelvic control, provides proximal stability that is essential for efficient and coordinated distal movements. Although this relationship may be bidirectional, the evidence from this review suggests that core stability contributes significantly to enhancing lower limb performance through its central role in the kinetic chain. Further research is warranted to explore and confirm the directional influence and underlying mechanisms involved.

Components and Parameters of Core Stability Exercises

Based on analysis, the combination of isometric and isotonic exercises was found to be the most favoured approach in five out of seven trials reviewed. The scientific rationale behind this finding may lie in the complementary nature of these two types of muscle actions. While isometric exercises promote sustained activation of slow-twitch muscle fibres essential for postural control and stability, isotonic exercises involve dynamic movements that enhance strength and functional performance. Together, they may provide a more comprehensive stimulus for improving core strength and stability, leading to better outcomes in lower limb function (45). As for the parameter of isometric exercise, 5-second hold with 8 repetitions per set was commonly used in the trials. While there is no consensus on the optimal duration to sustain the isometric contraction, previous review reported that sustained contractions of 5 seconds to 30 seconds per repetition were reported to be effective in improving maximal muscle strength and muscle mass, respectively (46). For isotonic exercises, 10 to 15 repetitions with 2 to 3 sets were most common prescription.

Across the seven trials reviewed, various core stability exercise routines were employed, including abdominal curls, bridges, side bridges, planks, quadrupedal stances, Sperman exercise, crisscross, vertical crunches, scissors, trunk rotations, transverse abdominis contractions, pelvic musculature strengthening and certain pilates exercises with modifications made in some of these basic exercise postures. These modifications include bridges (e.g., back bridge, unilateral bridge, shoulder bridge), quadruped exercises (e.g., arm lift, arm and lower extremity lift), curl-ups (e.g., curl up, roll down and up, cross curl ups), trunk rotations (with and without weights). Most frequently used exercises across seven trials were bridges (71.5%), followed by curl-ups and quadruped stance (each 57.15%) and isometric contraction of transverse abdominis contraction (43%). Sperman exercises, bicycles, double leg lowering, gluteal muscle exercises, transverse abdominis isometrics and single leg stance were next (each 28.57%) and remaining exercises were used less frequently, each comprising 14.28%. While all studies included multi-exercise interventions, curl ups, quadruped stance and bridges were among the most used exercises in studies reporting significant improvements in outcomes. However, due to the multi-component nature of these interventions, the effectiveness of any single exercise cannot be definitively determined. Instead, this review highlights the core components frequently incorporated in effective intervention programs, offering insight into exercises that may contribute to improved outcomes.

Table 6. Subgroup analysis of core stability interventions: exercise type, duration, and outcome measures

Subgroup analysis based on exercise type		
Exercise type	**Number of studies**	**Findings**
Isometric only	n=1 (30)	No significant improvement in pain, balance, or functional performance compared to conventional exercise group (30).
Isometric + isotonic	n=4 (31-36)	Significant improvements in pain, function, trunk stability, balance, physical performance, foot posture, lower limb muscle strength and knee stability (31, 32, 34-36).
Isotonic only	n=1 (33)	No improvements in weight distribution and foot load response (34).
		Significant improvements in pain and balance (33).
Subgroup analysis based on intervention duration		
Intervention duration	**Number of studies**	**Findings**
<6 weeks	n=3 (31, 33, 34)	Improvements noted in balance, trunk stability, foot posture, and pain (31, 33, 34).
		No improvements for weight distribution and load response (34).
≥6 weeks	n=4 (30, 32, 35, 36)	Majority of studies (32, 35, 36) reported improvements in pain, ADLs, quality of life, functional tests, and lower limb muscle strength.
		One study (30) showed no improvements in pain, balance, or function.
Subgroup analysis based on outcome measures		
Outcome measure	**Number of studies**	**Findings**
Pain	n=5 (30-33, 35)	All studies except one (30) reported significant improvements in pain.
Balance	n=3 (30, 31, 33)	All studies except one (30) reported significant improvements in balance.
Functional independence	n=3 (30, 32, 35, 36)	All studies except one (30) reported significant improvements in functional independence.
Physical performance and mobility	n=2 (31, 32)	Both studies reported significant improvements in physical performance (31, 32).
Lower limb muscle strength	n=2 (31, 36)	One study reported no significant improvements (31) while other study reported significant improvement (36).
Foot posture and weight distribution	n=1 (34)	Significant improvements in foot posture but no significant improvements in weight distribution and foot load response (34).
Knee stability	n=1 (36)	Significant improvements in knee stability reported (36)

These exercise routines activated both global muscles of the core (erector spinae, quadratus lumborum, obliques, and rectus abdominis) and local muscles (transverse abdominis and multifidus). It has been suggested that rehabilitation strategy should incorporate all muscles around the trunk as the global muscles of the core produce torque to counter external force, while the local muscles of the core (transverses abdominis and multifidus) stabilize the trunk (47).

The findings from the selected studies (30-36), show that the overall duration and delivery modes of the core stability training across the seven trials varied. However, most of the trials involved 3 sessions weekly (30,31,33,36), with a range from 2 to 6 times per week. The duration of these programs spanned from 4 to 12 weeks, with each session lasting 30 to 60 minutes. The heterogeneity in the length of the intervention was due to the different training dosages employed in the trials.

A finer analysis of the seven trials revealed that three studies with intervention durations of less than six weeks reported positive outcomes, while three out of four studies with durations of six weeks or more also demonstrated favourable results. One trial, which did not report significant improvements compared to conventional treatment, had an intervention period of six weeks. This suggests that the duration of intervention, whether less than or equal to six weeks did not markedly influence the overall effectiveness. This observation aligns with findings from previous epidemiological studies, which suggest that the effects of increase in muscle strength is evident after after 4 weeks of strength training (48).

Limitations

A key limitation of this review is the small number of included studies (n=7), which may limit generalizability. This resulted from strict inclusion criteria focusing on nonathletic adults with lower limb dysfunctions managed conservatively. While enhancing specificity and clinical relevance, it excluded many studies on athletic, neurologically impaired populations, and participants who had undergone surgeries, whose core stability programs are typically more advanced or condition-specific respectively.

The methodological quality of the included studies ranged from fair to good. Common flaws included lack of patient and therapist blinding in all studies, lack of assessor blinding in more than half, absence of concealed allocation in some trials,

and incomplete follow-up data in others. These methodological weaknesses may have introduced various forms of bias and affect the internal validity of the findings.

Furthermore, there was considerable heterogeneity across studies in terms of exercise protocols, outcome measures, and participant characteristics. The absence of standardized core stability training protocols and differing assessment tools reduced the ability to directly compare study outcomes. These variations, along with small sample sizes in most studies and the absence of long-term follow-up data, limit the reliability and sustainability of the reported effects. Due to these substantial differences in study designs and interventions, conducting a meta-analysis was not feasible. The variability in training duration, intensity, frequency, and targeted muscle groups restricted meaningful statistical pooling.

Lastly, because core stability exercises were delivered as part of multi-component interventions in all included studies, it was not possible to isolate and determine the effectiveness of specific exercises or routines. This prevents drawing firm conclusions on which components are most beneficial or have the greatest impact on lower limb dysfunctions.

Despite these limitations, the studies consistently reported positive outcomes related to core stability training for lower limb dysfunctions, suggesting that this intervention may be effective in improving functional performance and reducing movement deficits. However, caution should be exercised when interpreting these findings.

Future Research Directions

Future studies should aim to overcome the methodological limitations identified in this review, such as incorporating larger sample sizes, long-term follow-ups, ensuring better blinding, and implementing standardized protocols for core stability training.

Well-designed randomized controlled trials that isolate specific exercise components and focus on regions of the lower limbs (e.g., hip, knee, ankle) are needed to clarify their differential effects of each component. Long-term follow-up data should also be included to assess the durability of the intervention outcomes. Additionally, comparative studies evaluating core stability training against other rehabilitation strategies such as neuromuscular or strength training would provide deeper insights into the relative efficacy of each approach.

To enable meaningful meta-analytical evaluations in the future, it is essential that studies minimize heterogeneity in terms of intervention protocols, outcome measures, and participant characteristics. Standardizing these aspects will not only improve the comparability of findings across studies but also will enhance the quality and applicability of findings.

CONCLUSION

This review provides initial evidence suggesting a meaningful relationship between core stability and lower limb functions, paving the way for more comprehensive experimental studies to explore this connection further. Activation of core muscles seems to provide a stable base for the execution of lower limb movements, highlighting the importance of kinetic chains in rehabilitation. Combination of isometric and isotonic exercises particularly curl-ups, bridges, quadruped postures and isometric contraction of transverse abdominis were most frequently used. However, the effects of individual exercises could not be isolated due to the multi- component nature of the interventions. Given this limitation future research should explore individual effects of each exercise routine in various lower limb dysfunctions. This will offer a deeper and clearer insight about the most effective components of core stability training and their effect on the outcomes of rehabilitation.

Even though the core stability exercises showed the promise of encouraging results, short term follow ups, smaller sample sizes, methodological weaknesses, and heterogeneity in studies restricted a definitive conclusion. Therefore, despite encouraging outcomes, further high quality, targeted research is necessary to optimize study design and clinical application.

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REFERENCES

1. Frizziero A, Pellizzon G, Vittadini F, Bigliardi D, Costantino C. Efficacy of core stability in non-specific chronic low back pain. J Funct Morphol Kinesiol. 2021;6(2):37.

2. De Blaiser C, Roosen P, Willems T, Danneels L, Bossche LV, De Ridder R. Is core stability a risk factor for lower extremity injuries in an athletic population? A systematic review. Phys Ther Sport. 2018;30:48-56.
3. Unal-Suzer N, Buker N, Suzer A. Examining the correlation between hip adductor muscle strength, core stabilization, and lower extremity performance in healthy individuals. Turk J Physiother Rehabil. 2024;35:224-35.
4. Kuyulu Haksal P, Polat H, Ergun N. Investigation of the relationship between core stability and balance and lower extremity power in adolescent female basketball players. Turk J Physiother Rehabil. 2024;35(3):373-81.
5. Kibler WB, Press J, Sciascia A. The role of core stability in athletic function. Sports Med. 2006;36(3):189-98.
6. Liemohn WP, Baumgartner TA, Gagnon LH. Measuring core stability. J Strength Cond Res. 2005;19(3):583-6.
7. Daggfeldt K, Thorstensson A. The role of intra-abdominal pressure in spinal unloading. J Biomech. 1997;30(11-12):1149-55.
8. Hodges PW. Core stability exercise in chronic low back pain. Orthop Clin North Am. 2003;34(2):245-54.
9. Putnam CA. Sequential motions of body segments in striking and throwing skills: Descriptions and explanations. J Biomech. 1993;26(1):125-35.
10. Stephenson J, Swank AM. Core training: designing a program for anyone. Strength and Conditioning Journal. 2004;26(6):34-7.
11. Hodges PW, Richardson CA. Contraction of the abdominal muscles associated with movement of the lower limb. Phys Ther. 1997;77(2):132-42.
12. Ireland ML, Willson JD, Ballantyne BT, Davis IM. Hip strength in females with and without patellofemoral pain. J Orthop Sports Phys Ther. 2003;33(11):671-6.
13. Elataar FF, Abdelmajeed SF, Abdellatif NMN, Mohammed MM. Core muscles' endurance in flexible flatfeet: A cross - sectional study. J Musculoskelet Neuronal Interact. 2020;20(3):404-10.
14. Beckman SM, Buchanan TS. Ankle inversion injury and hypermobility: effect on hip and ankle muscle electromyography onset latency. Arch Phys Med Rehabil. 1995;76(12):1138-43.
15. Willson JD, Dougherty CP, Ireland ML, Davis IM. Core stability and its relationship to lower extremity function and injury. J Am Acad Orthop Surg. 2005;13(5):316-25.
16. Modi M, Bhatt G. The effect of core stability training on dynamic balance and lower extremity performance in young, asymptomatic individuals. Int J Physiother Res. 2017;5(6):2451-6.
17. Gong J, Gao H, Sui J, Qi F. The effect of core stability training on the balance ability of young male basketball players. Front Physiol. 2024;14:1305651.
18. Yasul Y, Akdemir E, Öner S, Anıl B, Korkmaz E, Pekesen Kurtça M, et al. The Effect of Core Training Practices on Some Strength, Lower Limb Functions and Balance Performance in Judo Athletes. Int J Disabil Sports Health Sci. 2023;6(3):507-20.
19. Khale NL, Gribble PA. Core Stability Training in Dynamic Balance Testing Among Young, Healthy Adults. Athletic Training & Sports Health Care. 2009;1(2):65-73.
20. Lyons KD, Parks AG, Dadematthews OD, Zandieh NL, McHenry PA, Games KE, et al. Core and Whole-Body Vibration Exercise Improve Military Foot March Performance in Novice Trainees: A Randomized Controlled Trial. Mil Med. 2023;188(1-2):e254-e9.
21. Degens H, Stasiulis A, Skurvydas A, Statkeviciene B, Venckunas T. Physiological comparison between non-athletes, endurance, power and team athletes. Eur J Appl Physiol. 2019;119(3):1377-86.
22. Perraton LG, Kumar S, Machotka Z. Exercise parameters in the treatment of clinical depression: a systematic review of randomized controlled trials. J Eval Clin Pract. 2010;16(3):597-604.
23. Harvie D, O'Leary T, Kumar S. A systematic review of randomized controlled trials on exercise parameters in the treatment of patellofemoral pain: what works? J Multidiscip Healthc. 2011; 4:383-92.
24. Pastakia K, Kumar S. Exercise parameters in the management of breast cancer: a systematic review of randomized controlled trials. Physiother Res Int. 2011;16(4):237-44.
25. Young JL, Rhon DI, Cleland JA, Snodgrass SJ. The influence of exercise dosing on outcomes in patients with knee disorders: a systematic review. J Orthop Sports Phys Ther. 2018;48(3):146-61.
26. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021;372:n71.
27. Tawfik GM, Dila KAS, Mohamed MYF, Tam DNH, Kien ND, Ahmed AM, et al. A step-by-step guide for conducting a systematic review and meta-analysis with simulation data. Trop Med Health. 2019;47:46.
28. Paci M, Bianchini C, Baccini M. Reliability of the PEDro scale: comparison between trials published in predatory and non-predatory journals. Arch Physiother. 2022;12(1):10.
29. Cashin AG, McAuley JH. Clinimetrics: physiotherapy evidence database (PEDro) scale. J Physiother. 2020;66(1):59.
30. Lam JE, Mokhtar AH, Mohafez H. Effect of core strengthening for knee osteoarthritis on balance, pain and function: a pilot study. JUMMEC. 2023;26(1):122-34.
31. Kim J, Ko J, Lim J, Choi H, Seo K, Lee S. Effects of a four-week core stability exercise on functional movement and balance in people with mild lower-limb discomfort. Monten J Sports Sci Med. 2020;9(2):13-20.
32. Hoglund LT, Pontiggia L, Kelly JD 4th. A 6-week hip muscle strengthening and lumbopelvic-hip core stabilization program to improve pain, function, and quality of life in persons with patellofemoral osteoarthritis: a feasibility pilot study. Pilot Feasibility Stud. 2018;4(1):70.
33. Chevidikunnan MF, Al Saif A, Gaowgzeh RA, Mamdouh KA. Effectiveness of core muscle strengthening for improving pain and dynamic balance among female patients with patellofemoral pain syndrome. J Phys Ther Sci. 2016;28(5):1518-23.
34. Pachava SR, Shobhan P, Mulpuri S. Comparison of the effect of 4 weeks core stability training and foot intrinsic muscle training on foot posture. Int J Health Sci. 2022;6(3):3788-99.
35. Tazesh B, Mansournia MA, Halabchi F. Additional effects of core stability exercises on pain and function of patients with patellofemoral pain: A randomized controlled trial. Journal of Orthopaedics, Trauma and Rehabilitation. 2022;29:1-7.
36. Çelik D, Turkel N. The effectiveness of pilates for partial anterior cruciate ligament injury. Knee Surg Sports Traumatol Arthrosc. 2017;25(8):2357-64.
37. Bullock-Saxton JE, Janda V, Bullock MI. The influence of ankle sprain injury on muscle activation during hip extension. Int J Sports Med. 1994;15(6):330-4.
38. Fredericson M, Cookingham CL, Chaudhari AM, Dowdell BC, Oestreicher N, Sahrmann SA. Hip abductor weakness in distance runners with iliotibial band syndrome. Clin J Sport Med. 2000;10(3):169-75.
39. Leetun DT, Ireland ML, Willson JD, Ballantyne BT, Davis IM. Core stability measures as risk factors for lower extremity injury in athletes. Med Sci Sports Exerc. 2004;36(6):926-34.
40. Hewett TE, Lindenfeld TN, Riccobene JV, Noyes FR. The effect of neuromuscular training on the incidence of knee injury in female athletes. A prospective study. Am J Sports Med. 1999;27(6):699-706.

41. Aman JE, Elangovan N, Yeh IL, Konczak J. The effectiveness of proprioceptive training for improving motor function: a systematic review. Front Hum Neurosci. 2015;8:1075.

42. Ding X, Yang Y, Xing Y, Jia Q, Liu Q, Zhang J. Efficacy of lower limb strengthening exercises based on different muscle contraction characteristics for knee osteoarthritis: a systematic review and network meta-analysis. Front Med (Lausanne). 2024;11:1442683.

43. Almansoof HS, Nuhmani S, Muaidi Q. Role of kinetic chain in sports performance and injury risk: a narrative review. J Med Life. 2023;16(11):1591-6.

44. Huxel Bliven KC, Anderson BE. Core stability training for injury prevention. Sports Health. 2013;5(6):514-22.

45. Khaledi A, Gheitasi M. isometric vs isotonic core stabilization exercises to improve pain and disability inpatients with non-specific chronic low back pain: A Randomized Controlled Trial. Anesth Pain Med. 2024;14(1):e144046.

46. Lum D, Barbosa TM. Brief Review: Effects of isometric strength training on strength and dynamic performance. Int J Sports Med. 2019;40(6):363-75.

47. Brumitt J, Matheson JW, Meira EP. Core stabilization exercise prescription, part I: current concepts in assessment and intervention. Sports Health. 2013;5(6):504-9.

48. Del Vecchio A, Casolo A, Negro F, Scorcelletti M, Bazzucchi I, Enoka R, et al. The increase in muscle force after 4 weeks of strength training is mediated by adaptations in motor unit recruitment and rate coding. J Physiol. 2019;597(7):1873-87.