The European Research Journal 2025;11(2):296-303 Original Article

DOI: https://doi.org/10.18621/eurj.1603630 *Sports Health Sciences*

The effects of a 6-week pilates exercises on quality of life, depression, and musculoskeletal disorders in menopausal women

Sema Arslan Kabasakal

Department of Sports Health Sciences, Faculty of Sports Science, Yalova University, Yalova, Türkiye

ABSTRACT

Objectives: This study examines the impact of a 6-week Pilates intervention on quality of life, depression, and musculoskeletal disorders in menopausal women.

Methods: The sample comprised 13 menopausal women with a mean age of 59.45±11.52 years. Data collection was conducted using the World Health Organization Quality of Life-BREF (WHOQOL-BREF), the Beck Depression Inventory for Primary Care (BDI-PC), and the Cornell Musculoskeletal System Discomfort Questionnaire (CMSDQ). These instruments were administered at three intervals: baseline, following a 6-week non-intervention period, and after a subsequent 6-week Pilates program.

Results: Within the scope of the study findings, after 6 weeks of Pilates, there was a significant increase in the participants' quality of life scores in the physical and psychological health domains and a significant decrease in the BDI-PC total score (For physical health domains: $\eta 2=0.62$, $P<0.001$; for psychological health domains: $\eta 2=0.56$, $P<0.001$; for BDI-PC total score: $\eta 2=0.51$, $P<0.05$). However, no statistically significant difference was found in participants' quality of life scores in the social relations and environmental health domains and the CMSDQ total weighted score after 6 weeks of Pilates ($P>0.05$).

Conclusions: In conclusion, six weeks of Pilates exercises in menopausal women increases the quality of life within the framework of physical health and psychological health and reduces the depression level of these women. Therefore, to reduce the psychological problems that may occur in menopausal women and to improve their quality of life, they should be directed towards physical activities, especially Pilates. It is recommended to study the effect of Pilates performed for more than 6 weeks musculoskeletal disorders, environmental health and social relationships in this population.

Keywords: Physical activity, menopause, women, depression, musculoskeletal disorders, quality of life

Menopause is a "life change" period that occurs in women, usually between the ages of 45 and 55, with a decrease in estrogen levels, ovarian insufficiency, the end of the menstrual cycle, and the loss of reproductive functions [1, 2]. This decline is accompanied by several physiological and psychological changes. These changes lead to differences in reproductive health, bone density, muscle strength, and general health [3]. Particularly during menopause, women are more likely to experience

Corresponding author: Sema Arslan Kabasakal, PhD., Assist. Prof., Phone: +90 226 815 67 29 ext. 6729, E-mail: sema.kabasakal@yalova.edu.tr

How to cite this article: Arslan Kabasakal S. The effects of a 6-week pilates exercises on quality of life, depression, and musculoskeletal disorders in menopausal women. Eur Res J. 2025;11(2):296-303. doi: 10.18621/eurj.1603630

Received: December 18, 2024
Accepted: January 26, 2025
Published Online: February 5, 2025

health problems such as musculoskeletal disorders and chronic pain [4-6].

The quality of life of individuals can be affected by their physical health [7, 8]. Musculoskeletal disorders, which are common in women during menopause, lead to a decrease in their quality of life, limit their activities of daily living, and negatively affect their physical and psychological health [5, 9, 10]. Especially during this period, depression, which is a psychological health problem, is seen at a high rate [11]. In this context, physical and psychological health should be supported to protect and increase the quality of life in women during menopause [12]. Exercise plays an important role in this support [7, 13].

One type of exercise, Pilates, is an effective method for regulating musculoskeletal health and reducing symptoms of depression [14, 15]. Pilates, which is particularly inexpensive and has a wide variety of exercises, has a low risk of causing pain and increases the individual's postural balance, muscle flexibility, and strength [16, 17]. Aibar-Almazán *et al*. [18] found that a Pilates exercise program in postmenopausal women had beneficial effects on sleep quality, anxiety, depression, and fatigue. A study by Farzaneh *et al*. [19] suggested that Pilates training could improve mental and physical functioning and reduce depression (67%) and anxiety (53%). In patients with chronic low back pain, only Pilates exercises were found to be effective in reducing pain and depression [20, 21]. In a meta-analysis study, Pilates was found to affect pain control in people with fibromyalgia [22]. Pilates was also found to reduce pain and disability and improve the quality of life in women [23]. In addition, it was found to reduce depression and increase the quality of life in overweight and obese individuals [24]. This study aimed to investigate the effects of 6 weeks of Pilates exercise on quality of life, depression, and musculoskeletal disorders in menopausal women. The results of this study will contribute to the development of health policies to improve the quality of life of menopausal women and provide a scientific basis for the integration of health and exercise science.

METHODS

Research Design

This study is a quasi-experimental study with a 6-week intervention, with repeated measures in a single group.

Subjects

The study included 13 sedentary menopausal women. The average age of the participants was 59.45±11.52 years, they had an average weight of 88.68±11.14 kg and a height of 160.42±5.07 cm. The criteria for inclusion and exclusion from the study are listed below.

Criteria for inclusion in the study;

- Being in menopause
- Being sedentary and not doing active exercise
- Not having a health problem that would prevent them from exercising
- Not having had a surgery that would affect the musculoskeletal system in the last year

Criteria for exclusion from the study;

- Voluntarily leaving the study
- Not following the procedures required by the study
- Arbitrarily disrupting the exercise schedule more than 2 times

Procedure

The study aims to determine the effects of 6 weeks of Pilates exercise on quality of life, depression, and musculoskeletal disorders in menopausal women. 15 participants were initially included in the study. However, two participants were excluded from the analysis because they did not participate regularly in the exercise program during the study. The study was conducted with 13 menopausal women. The participants were assessed using the Cornell Musculoskeletal Disorder Scale, the World Health Organisation Quality of Life-BREF (WHOQOL-BREF), and the Beck Depression Inventory for Primary Care. No intervention was then carried out for 6 weeks, and the tests were repeated a second time after the 6th week. After that, the participants did Pilates exercises 2 days a week for 6 weeks, and then their third test was taken.

Data Collection Tools

Participant Demographic Form

This form queried the participants' age, gender,

weight, height, whether they were in menopause, whether they exercised regularly, whether there was a condition that would prevent them from exercising, and whether they had undergone surgery that would affect their musculoskeletal system in the last year. Participants to be included in the study were determined based on the results of this form.

The World Health Organization Quality of Life - BREF (WHOQOL-BREF)

The World Health Organization Quality of Life - BREF (WHOQOL-BREF) was developed in 1988 [27] and its Turkish validity and reliability were performed by Eser *et al*. [28]. WHOQOL-BREF consists of 27 questions. WHOQOL-BREF measures individuals' quality of physical health (questions 3, 4, 10, 15, 16, 17, 18), quality of psychological health (questions 5, 6, 7, 11, 19, 26), quality of social relationships (questions 20, 21, 22), and quality of environmental health (questions 8, 9, 12, 13, 14, 23, 24, 25, 27). The scale has a 5-point Likert structure. The total score of each subheading was multiplied by 5 and evaluated out of 100 points. An increase in the score obtained from the scale indicates that the quality of life in the relevant category increases [29].

Beck Depression Inventory for Primary Care (BDI-PC)

The scale, developed by Beck *et al*. [25] in 1997, was adapted into Turkish by Aktürk *et al*. [26] in 2005. The scale screens for depression under seven headings using symptoms of sadness, pessimism, past failures, self-dislike, self-blame, loss of interest, and suicidal ideation or desire. Each heading includes a rating from zero to three. A total score of a minimum of zero and a maximum of 21 is obtained [26]. The analysis was conducted on the total score in the current study.

Cornell Musculoskeletal System Discomfort Questionnaire (CMSDQ)

The Cornell Musculoskeletal System Discomfort Questionnaire (CMSDQ) was developed by Cornell University and its Turkish validity and reliability were performed by Erdinç *et al*. [30]. The CMSDQ allows the assessment of 20 separate body regions (neck, right and left shoulder, back, right and left upper arm, waist, right and left forearm, right and left wrist, hip, right and left upper leg, right and left knee, right and left lower leg, right and left foot). The frequency, severity, and work-interference status of pain, aching, or discomfort felt in these regions in the last 7 days are questioned. The weighted score for each body region is calculated by multiplying the scores it receives for pain frequency, severity, and work-interference status. The weighted score ranges between 0 and 90 for each body region. An increase in the score indicates that the frequency, severity, and effect of the pain on work increase [30, 31]. Total weighted score was used in this study.

Pilates Exercises

The Pilates exercise program was conducted twice a week for six weeks, with each session lasting 60 minutes and divided into three phases: a 10-minute warm-up, a 40-minute main exercise period, and a 10-minute cool-down. The warm-up phase included 4 minutes of low-intensity on-the-spot marching to gradually increase heart rate, followed by 6 minutes of dynamic and static stretching exercises targeting major muscle groups such as the hamstrings, quadriceps, and shoulders to improve flexibility and prepare the body for the main exercises. The main exercise period consisted of 3 main phases that changed every two weeks according to the difficulty level. During each phase, participants performed foundational Pilates movements, starting with 2 sets of 10 repetitions for each movement in the first week, which were increased to 2 sets of 15 repetitions from the second week onward to ensure gradual progression. The main Pilates exercise program is included in Table 1. The cool-down phase involved 4 minutes of low-intensity on-the-spot marching to lower the heart rate, followed by 6 minutes of static stretching focused on the muscles engaged during the main workout, such as the lower back, hamstrings, and shoulders, to promote relaxation and reduce muscle tension.

Ethical Consideration

Ethics committee permission for the study was received from Yalova University Ethics Committees Coordination on 01.10.2024 with protocol number 2024/227. Participants were informed about the study and filled out an informed consent form. Participants were included in the study on a voluntary basis. The current research is in accordance with the Declaration of Helsinki.

Table 1. Pilates exercises program

Weeks 1-2	Weeks 3-4	Weeks 5-6
Pelvic curl	Push Up	Arm abduction with band
Chest lift	Overhead shoulder openers	Standing flies with band
Side lying leg circles	Glute bridge leg lifts	Russian twist
Lateral lunges	Swan prep	Scissor crunches
	Child's pose	Kneeling arm and leg reach
	Plank jack	Cat-cow

Statistical Analysis

IBM SPSS Statistics 25.0 program was used in the application of the analyses and the evaluation of the data. Since the skewness and kurtosis values of the obtained data were between (-1.5) and (1.5), the data were normally distributed [32]. For this reason, parametric tests were preferred in data analysis. Descriptive statistics and ANOVA tests were used in the analysis of the data. The statistical significance level was determined as $P<0.05$. The effect of the mean score difference between the variables was evaluated with the eta squared ($\eta 2$) value. The $\eta 2$ value range was considered as "0.01-small effect power, 0.06-medium effect power, 0.14 and above - large effect power" [33].

RESULTS

In Table 1, to examine the effect of pilates exercises, 3 different measurements were made to the same group and the differences between the measurements were examined with the Repeated Measures ANOVA test.

For the participants' quality of life scores in the Physical health domain, the Mauchly's test provided the assumption of sphericity ($X2(2)=4.042$, $P=0.133$). A significant difference was found between the three different measurements ($F(2,22)=17.949$, $P<0.001$, $\eta 2=0.62$). When the source of the difference was examined with post hoc tests, it was found to be between the post-pilates measurement (65.77±4.49) and the first measurement (54.46±4.70) and the second measurement (57.14±4.48) ($P<0.05$) (Table 2). The participants' quality of life scores in the Physical Health domain increased statistically significantly after Pilates ($P<0.05$).

Mauchly's test sphericity assumption was met for the participants' quality of life scores in the domain of psychological health ($X2(2)=4.270$, $P=0.118$). There was a significant difference between three different measurements ($F(2,22)=13.888$, $P<0.001$, $\eta 2=0.558$). When the source of the difference was examined with post hoc tests, it was found to be between the post-pilates measurement (60.42±4.37) and the first measurement (52.43±3.75) and the second measurement (52.43±3.92) ($P<0.05$) (Table 2). The participants' quality of life scores in the psychological health domain increased significantly after Pilates ($P<0.05$).

The Mauchly's test assumption of sphericity was violated for the participants' quality of life scores in the Social relationships domain ($X2(2)=12.738$, $P=0.002$). For this reason, Greenhouse-Geisser correction was applied and no significant difference was found between the three different measurements ($F(1.16, 12.79)=3.951$, $P=0.063$, $\eta 2=0.264$) (Table 2). After Pilates, the participants' quality of life scores in the social relations area did not differ significantly ($P>0.05$).

Mauchly's test sphericity assumption was met for the participants' quality of life scores in the field of Environmental health ($X2(2)=2.521$, $P=0.284$). No significant difference was found between the three different measurements ($F(2,22)=2.118$, $P=0.144$, $\eta 2=0.161$) (Table 2). No statistically significant difference was found in the participants' quality of life scores in the environmental health area after Pilates ($P>0.05$).

Mauchly's test assumption of sphericity is not provided for the participants' Beck Depression scores ($X2(2)=10.462$, $P=0.005$). Therefore, Greenhouse-Geisser correction was applied. A significant difference was found between the three different

Table 2. Differences between the measurements made at 3 different times regarding the participants' quality of life, depression, musculoskeletal disorders

Scales/ Domains		Measurement	Mean	SD	F	P value	η^2	Post-hoc (Bonferroni)
WHOQOL-BREF	**Physical health**	First pre-pilates (1)	54.46	4.70	17.95	**<0.001**	0.62	3>1, **P=0.002***; 3>2, **P=0.005***
		Second pre-pilates (2)	57.14	4.48				
		Post-pilates (3)	65.77	4.49				
	Psychological health	First pre-pilates (1)	52.43	3.75	13.89	**<0.001**	0.56	3>1, **P=0.008***; 3>2, **P=0.004***
		Second pre-pilates (2)	52.43	3.92				
		Post-pilates (3)	60.42	4.37				
	Social relationships	First pre-pilates (1)	52.08	4.12	3.95	0.064	0.26	P>0.05
		Second pre-pilates (2)	52.78	4.63				
		Post-pilates (3)	59.72	4.68				
	Environmental health	First pre-pilates (1)	43.06	6.14	2.12	0.144	0.16	P>0.05
		Second pre-pilates (2)	41.20	6.21				
		Post-pilates (3)	45.14	5.07				
BDI-PC (total score)		First pre-pilates (1)	4.67	1.35	11.31	**0.004**	0.51	1>3, **P=0.033***; 2>3, **P=0.006***
		Second pre-pilates (2)	5.00	1.26				
		Post-pilates (3)	2.00	0.70				
CMSDQ (total score		First pre-pilates (1)	26.25	6.04	0.78	0.396	0.07	P>0.05
		Second pre-pilates (2)	26.67	5.94				
		Post-pilates (3)	44.58	18.91				

BDI-PC=Beck Depression Inventory for Primary Care, WHOQOL-BREF= The World Health Organisation Quality of Life – BREF, CMSDQ=Cornell Musculoskeletal System Discomfort Questionnaire, SD=standard deviation
*P<0.05

measurements (F(1.21, 13.34)=11.31, P=0.004, η2=0.507). When the source of the difference was examined with post hoc tests, it was found to be between the post-pilates measurement (2.00±0.69) and the first measurement (4.67±1.35) and the second measurement (4.67±1.35) (P<0.05) (Table 2). A significant decrease was found in the participants' depression scores after Pilates (P<0.05).

Mauchly's test assumption of sphericity is not provided for the participants' CMSDQ total weighted scores (X2(2)=52.564, P<0.001). In this direction, Greenhouse-Geisser correction was made and no significant difference was found between the three different measurements (F(1, 22)=0.780, P=0.396, η2=0.066) (Table 2). No statistically significant change was found in the participants' CMSDQ total weighted scores after Pilates (P>0.05).

DISCUSSION

This study investigated the effects of six weeks of Pilates on the physical and psychological quality of life of menopausal women. The results of the study show that Pilates exercises are effective in improving the physical and psychological quality of life of

menopausal women. Studies in the literature support the fact that Pilates increases muscle strength in menopausal women, provides physical and psychological fitness and improves quality of life [34]. Lee *et al*. [35] found that Pilates helps protect physical and mental health by improving body composition and hormonal balance in menopausal women. In addition, studies show that Pilates provides psychological well-being by reducing fatigue, which is common during this period [36]. Persaki *et al*. [37] found that it improved the quality of life in terms of general health and social functioning. However, in the current study, it was observed that 6 weeks of Pilates did not affect the social and environmental quality of life of the participants. This difference may have been observed because the Pilates exercises were performed for 16 weeks in the study by Persaki *et al*. [37]. In conclusion, Pilates can be used to improve the physical and psychological quality of life of menopausal women. However, Pilates should be done for more than 6 weeks to improve social and environmental quality of life. It is recommended that similar studies are carried out in the future to investigate the effects of Pilates over a longer period.

Another important finding of the current study is that six weeks of Pilates reduces depression in menopausal women. Pilates is already recommended to improve symptoms of depression and anxiety in women [14]. In fact, Pilates was found to be more effective than aerobic exercise in reducing symptoms of depression in women with fibromyalgia [38]. Pilates alone has been shown to reduce anxiety in patients with chronic low back pain [20]. Farzaneh *et al*. [19] found that eight weeks of Pilates reduced anxiety in menopausal women. Other studies in menopausal women found that eight weeks [39, 40] and twelve weeks [18] of Pilates were effective in reducing depression. The Pilates program used in the current study lasts 6 weeks. In line with this finding, it can be argued that 6 weeks of Pilates is effective in reducing depression levels and improving psychological health in menopausal women.

In the current study, it is an unexpected finding that six weeks of Pilates did not affect musculoskeletal disorders in menopausal women. Normally, physical activity and postural health are closely related, which affects the musculoskeletal system [41]. It has been reported in the literature that Pilates exercises generally alleviate musculoskeletal problems [20, 42-44]. However, in our study, 6 weeks of Pilates did not have a significant effect on musculoskeletal disorders. This may be due to the small number of participants and the short duration of the exercise, or it may be that people's existing conditions were too chronic to be improved by exercise. The fact that the chronic pain levels of the participants were not measured with the pain questionnaire is a shortcoming of the study. It is recommended that future studies investigate the effects of longer-term Pilates, include a larger number of participants, or investigate whether different types of exercise programs are effective in this regard.

Limitations

In the current study, the fact that the duration of the Pilates program was limited to 6 weeks may have caused it to not affect musculoskeletal disorders. In addition, the limited number of participants in the study to thirteen people prevents this effect from being observed and the results from being generalized. It is recommended that future studies be conducted with a larger number of participants and that the time-dependent effects of Pilates be investigated in more detail. In addition, Pilates should be compared with other forms of exercise in menopausal women to determine the most effective form of exercise.

CONCLUSION

In conclusion, this study showed that six weeks of Pilates exercise can improve physical and psychological quality of life and reduce depression in menopausal women but has no significant effect on social and environmental quality of life or musculoskeletal disorders. These findings emphasize the importance of exercise during menopause but show that exercise programs should be tailored to the needs of the individual. According to the results of the study, Pilates exercises can be preferred to improve the quality of life of menopausal women and prevent possible psychological problems. Countries should develop plans and strategies to improve the physical activity levels of menopausal women as part of their health policies to improve women's health. In this way, excessive health expenditure can be avoided, the welfare of individuals in the country can be increased and social peace can

be maintained. Health professionals and sports scientists have a major responsibility in this process.

Ethical statement

Ethics Committee Permission for the study was received from Yalova University Ethics Committees Coordination on 01.10.2024 with protocol number 2024/227.

Authors' Contribution

Study Conception: SAK; Study Design: SAK; Supervision: SAK; Funding: SAK; Materials: SAK; Data Collection and/or Processing: SAK; Statistical Analysis and/or Data Interpretation: SAK; Literature Review: SAK; Manuscript Preparation: SAK and Critical Review: SAK.

Conflict of interest

The author disclosed no conflict of interest during the preparation or publication of this manuscript.

Financing

The author disclosed that they did not receive any grant during conduction or writing of this study.

REFERENCES

1. Australasian Menopause Society (AMS). What is menopause? Available at: https://www.menopause.org.au/hp/information-sheets/185-what-ismenopause. Accessed November 18, 2024.
2. North American Menopause Society (NAMS). Menopause 101: A primer for the perimenopausal. Available at: https://www.menopause.org/forwomen/menopauseflashes/menopause-symptoms-and-treatments/menopause-101-a-primer-for-theperimenopausal. Accessed 18 August 2024.
3. El Khoudary SR, Greendale G, Crawford SL, et al. The menopause transition and women's health at midlife: a progress report from the Study of Women's Health Across the Nation (SWAN). Menopause. 2019;26(10):1213-1227. doi: 10.1097/GME.0000000000001424.
4. Dugan SA, Powell LH, Kravitz HM, Rose SAE, Karavolos K, Luborsky J. Musculoskeletal pain and menopausal status. Clin J Pain. 2006;22(4):325-331. doi: 10.1097/01.ajp.0000208249.07949.d5.
5. Khadilkar SS. Musculoskeletal disorders and menopause. J Obstet Gynaecol India. 2019;69(2):99-103. doi: 10.1007/s13224-019-01213-7.
6. Lu CB, Liu PF, Zhou YS, et al. Musculoskeletal pain during the menopausal transition: A systematic review and meta−analysis. Neural Plast. 2020;2020:8842110. doi: 10.1155/2020/8842110.
7. Correa J, Cunha FA, Pires TH, Giani T, Ferreira MA, Dantas E. Effects of distinct physical activity and meditation programs on quality of life and depression levels in active elderly women. Eur J Hum Mov. 2009;23:1-13.
8. Özsoy D, Biçer T. Examination of life satisfaction in youth and sports volunteers. Pak J Med Health Sci. 2022;16(6):511-511. doi: 10.53350/pjmhs22166511.
9. Blümel JE, Arteaga E. Clinical Symptoms and Quality of Life: Insomnia and Muscle/Joint Aches. In: Antonio C, editors. Menopause: A Comprehensive Approach. Berlin: Springer; 2017. p. 79-90.
10. Frange C, Hachul H, Hirotsu C, Tufik S, Andersen ML. Insomnia with musculoskeletal pain in postmenopause: associations with symptoms, mood, and quality of life. J Menopausal Med. 2018;24(1):17-28. doi: 10.6118/jmm.2018.24.1.17.
11. Fu JX, Luo Y, Chen MZ, et al. Associations among menopausal status, menopausal symptoms, and depressive symptoms in midlife women in Hunan Province, China. Climacteric. 2020;23(3):259-266. doi: 10.1080/13697137.2019.1703936
12. Ye L, Knox B, Hickey M. Management of Menopause Symptoms and Quality of Life during the Menopause Transition. Endocrinol Metab Clin North Am. 2022;51(4):817-836. doi: 10.1016/j.ecl.2022.04.006.
13. Silva P, Novais C, Botelho-Gomes P, Carvalho J. Body's perceptions of elderly women in a physical activity program. Eur J Hum Mov. 2011;26:55-64.
14. Ju M, Zhang Z, Tao X, Lin Y, Gao L, Yu W. The impact of Pilates exercise for depression symptoms in female patients: A systematic review and meta-analysis. Med. 2023;102(41):e35419. doi: 10.1097/MD.0000000000035419.
15. Aksel KO, Unver B. Ab0128 Evaluation of the methodological quality of randomized controlled trials investigating the pilates method for fibromyalgia. Annals Rheum Dis. 2024;83(Suppl 1):1297-1298. doi: 10.1136/annrheumdis-2024-eular.3218.
16. Wells C, Kolt GS, Marshall P, Hill B, Bialocerkowski A. The effectiveness of Pilates exercise in people with chronic low back pain: a systematic review. PLoS One. 2014;9(7):e100402. doi: 10.1371/journal.pone.0100402.
17. Souza Cavina APD, Junior EP, Machado AF, et al. Effects of the mat pilates method on body composition: systematic review with meta-analysis. J Phys Act Health. 2020;17(6):673-681. doi: 10.1123/jpah.2019-0171.
18. Aibar-Almazán A, Hita-Contreras F, Cruz-Díaz D, de la Torre-Cruz M, Jiménez-García JD, Martínez-Amat A. Effects of Pilates training on sleep quality, anxiety, depression and fatigue in postmenopausal women: A randomized controlled trial. Maturitas. 2019;124:62-67. doi: 10.1016/j.maturitas.2019.03.019.
19. Farzaneh A, Koushkie Jahromi M, Salesi M, Rostami R. The Ameliorating impact of pilates training on anxiety and body mass index in menopausal symptoms. Women's Health Bull. 2020;7(4):46-53. doi: 10.30476/whb.2020.88198.1084.
20. Amaral S, Passaro ADC, Casarotto RA. Effect of the association of continuous shortwave diathermy and Pilates-based exercises on pain, depression, and anxiety in chronic non-specific low back pain: a randomized clinical trial. Braz J Med Biol Res 2023;56:e12338.

21. Huang J, Park HY. Effect of pilates training on pain and disability in patients with chronic low back pain: a systematic review and meta-analysis based on randomized controlled trials. Phys Act Nutr. 2023;27(1):16-29. doi: 10.20463/pan.2023.0003.
22. Jesus DXGD, Pacheco CDR, Rezende RM. The use of Pilates for pain control in patients with fibromyalgia. Fisioter Mov. 2022;35:e35204. doi: 10.1590/fm.2022.35204.
23. Parveen A, Kalra S, Jain S. Effects of Pilates on health and well-being of women: a systematic review. Bull Fac Phys Ther. 2023;28:17. doi: 10.1186/s43161-023-00128-9.
24. Vancini RL, Rayes ABR, Lira CABD, Sarro KJ, Andrade MS. Pilates and aerobic training improve levels of depression, anxiety and quality of life in overweight and obese individuals. Arq Neuropsiquiatr. 2017;75(12):850-857. doi: 10.1590/0004-282X20170149.
25. Beck AT, Guth D, Steer RA, Ball R. Screening for major depression disorders in medical inpatients with the Beck Depression Inventory for Primary Care. Behav Res Ther. 1997;35(8):785-791. doi: 10.1016/S0005-7967(97)00025-9.
26. Aktürk Z, Dağdeviren N, Ture M, Tuğlu C. [The reliability and validity analysis of the Turkish version of Beck Depression Inventory for primary care.] Türk Aile Hek Derg. 2005;9(3):117-122. [Article in Turkish]
27. WHOQOL Group. Development of the World Health Organization WHOQOL-BREF quality of life assessment. Psychol Med. 1998;28(3):551-558. doi: 10.1017/S0033291798006667.
28. Eser E, Fidaner H, Fidaner C, Eser SY, Elbi H, Göker E. [Psychometric properties of the WHOQOL-100 and WHOQOL-BREF]. 3P Dergisi.. 1999;7(Suppl 2):23-40. [Article in Turkish]
29. Saldıran TÇ. [Predicted effects of gender, physical activity and quality of life in internet addiction: University student sample]. J Depend. 2021;22(1):10-19. doi: 10.51982/bagimli.784565. [Article in Turkish]
30. Erdinc O, Hot K, Ozkaya M. Turkish version of the Cornell Musculoskeletal Discomfort Questionnaire: cross-cultural adaptation and validation. Work. 2011;39(3);251-260. doi: 10.3233/WOR-2011-1173.
31. Taşpınar F, Taşpınar B, Aksoy CC. [Investigation of musculoskeletal discomforts in physiotherapy and rehabilitation students]. Journal of Exercise Therapy and Rehabilitation.. 2014;1(2):55-60. [Article in Turkish]
32. Tabachnick BG, Fidell LS, Ullman JB. Using multivariate statistics. Boston, MA: Pearson; 2013.
33. Büyüköztürk Ş. Manual of Data Analysis for Social Sciences (Turkish: Sosyal Bilimler için Veri Analizi El Kitabı). Ankara: Pegem Academy Publisher; 2011.
34. Surve K, Suresh A, Flora J. A Literature review on effect of clinical mat pilates on health-related quality of life in menopausal women. EPRA Int J Multidiscip Res. 2024;10(5):869-878. doi: 10.36713/epra17182
35. Lee JM, Jo MS, Oh DJ. The effects of pilates on Body composition, Growth hormone, Insulin-like growth factor-1, Calcitonin, and Osteocalcin in middle-aged women after menopause. Korean J Sport Sci. 2023;32(5):699-710. doi: 10.35159/kjss.2023.10.32.5.699.
36. Mohamed DM, Hussien AMN, Kamel HEDH, Awad DMK. Effect of Pilates exercises on fatigue in post-menopausal women. Bull Fac Phys Ther. 2023;28:31. doi: 10.1186/s43161-023-00140-z.
37. Persaki DG, Nieri A, Apostolidis NG, Konstantinou E, Myrianthefs P. The Effect of Pilates on quality of sleep, aerobic capacity and anaerobic power in premenopausal women. Sleep Sci. 2024;17(1):e75-e81. doi: 10.1055/s-0043-1776742.
38.Cazotti LDA, Natour J, Carvalho F, Pereira DF, Jones A. OP0089-HPR Pilates is better than walking for patients with fibromyalgia: A randomized controlled trial. Annals Rheum Dis. 2023;82(Suppl 1):61. doi: 10.1136/annrheumdis-2023-eular.3961.
39. Lee HL, Caguicla JMC, Park S, et al. Effects of 8-week Pilates exercise program on menopausal symptoms and lumbar strength and flexibility in postmenopausal women. J Exerc Rehabil. 2016;12(3):247-251. doi: 10.12965/jer.1632630.315.
40. Özdemir ÖÇ, Uysal MF. [The effect of pilates exercise on quality of life and depression in postmenopausal period]. ACU Sağlık Bil Derg. 2019;10(1):20-26. doi: 10.31067/0.2019.103. [Article in Turkish]
41. Arslan Kabasakal S. Postüral Bozukluklar ve Fiziksel Aktivite. In: Fiziksel Aktivite ve Sağlık. Hazar F, ed., 1. Baskı. Efe Akademi Yayınları: İstanbul. 2023: p.263.
42. Denham−Jones L, Gaskell L, Spence N, Pigott T. A systematic review of the effectiveness of Pilates on pain, disability, physical function, and quality of life in older adults with chronic musculoskeletal conditions. Musculoskelet Care. 2022;20(1):10-30. doi: 10.1002/msc.1563.
43. Ravindran AK, Javed J, Parthiban R, Sherrif B. Effectiveness of aerobic exercise versus pilates in postmenopausal women with non-specific chronic low back pain. Indian J Physiother Occup Ther. 2022;16(2):1-8. doi: 10.37506/ijpot.v16i2.18026.
44. Jahan A, Anwer Z. Effectiveness of pilates and range of motion excercises in improving mechanical pain and functional performance in neck pain. Int J Membrane Sci Techno. 2023;10(2):2023-2029. doi: 10.15379/ijmst.v10i2.2743.