

ORIGINAL ARTICLE

Enhancing quality of life: the role of pilates in alleviating depression and anxiety among women: A randomized controlled trial

Yaşam kalitesinin artırılması: Pilatesin depresyon ve anksiyeteyi hafifletmede kadınlar üzerindeki rolü: Randomize kontrollü bir çalışma

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Abstract

Purpose: Depression and anxiety are among the most prevalent mental health disorders, significantly impairing individuals' quality of life. This study investigates the effects of Pilates exercises on depression, anxiety, and overall well-being in women over 50 years of age experiencing depression.

Methods: A randomized controlled trial (RCT) was conducted, involving 60 women diagnosed with depression by a psychiatrist. Participants were randomly assigned to either an experimental group (n=30), which engaged in 60-minute Pilates sessions three times weekly for eight weeks, or a control group (n=30), which maintained their usual routines. Depression, anxiety, and quality of life were assessed using the Beck Depression Inventory (BDI), Beck Anxiety Questionnaire (BAQ), and Short Form Health Survey (SF-36), respectively. ANOVA analysis was employed for data analysis.

Results: Results indicated that Pilates training significantly reduced depression (p=0.001) and improved both physical and mental aspects of quality of life (p=0.002). However, no significant effect was observed on anxiety levels (p=0.051).

Conclusion: A significant inverse relationship was found between anxiety and quality of life, as well as a direct correlation between depression and anxiety. These findings suggest that Pilates exercises may serve as an effective intervention for reducing depression and enhancing the quality of life in women suffering from depression.

Keywords: Anxiety, Depression, Quality of Life, Pilates, Randomized controlled trial.

Öz

Amaç: Depresyon ve anksiyete, bireylerin yaşam kalitesini önemli ölçüde düşüren, en yaygın görülen ruh sağlığı bozuklukları arasındadır. Bu çalışmanın amacı, depresyon yaşayan 50 yaş üstü kadınlarda Pilates egzersizlerinin depresyon, anksiyete ve genel refah düzeyi üzerindeki etkilerini araştırmaktır.

Yöntem: Bir psikiyatr tarafından depresyon tanısı konmuş 60 kadının katılımıyla randomize kontrollü bir çalışma (RKT) yürütülmüştür. Katılımcılar, sekiz hafta boyunca haftada üç kez 60 dakikalık Pilates seanslarına katılan bir deney grubu (n=30) veya normal rutinlerini sürdüren bir kontrol grubu (n=30) olarak rastgele atandı. Depresyon, anksiyete ve yaşam kalitesi sırasıyla Beck Depresyon Envanteri (BDE), Beck Anksiyete Ölçeği (BAÖ) ve Kısa Form-36 (SF-36) Sağlık Anketi kullanılarak değerlendirildi. Veri analizi için ANOVA analizi kullanıldı.

Bulgular: Sonuçlar, Pilates eğitiminin depresyonu önemli ölçüde azalttığını (p=0,001) ve yaşam kalitesinin hem fiziksel hem de zihinsel boyutlarını iyileştirdiğini (p=0,002) göstermiştir. Ancak, anksiyete düzeyleri üzerinde anlamlı bir etki gözlemlenmedi (p=0,051).

Sonuç: Anksiyete ile yaşam kalitesi arasında anlamlı bir ters ilişki ve ayrıca depresyon ile anksiyete arasında doğrudan bir ilişki bulundu. Bu bulgular, Pilates egzersizlerinin, depresyonu azaltmak ve yaşam kalitesini artırmak için etkili bir müdahale yöntemi olabileceğini düşündürmektedir.

Anahtar Kelimeler: Anksiyete, Depresyon, Yaşam kalitesi, Pilates, Randomize kontrollü çalışma.

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INTRODUCTION

Depression, a prevalent mental health condition, is characterized by symptoms including melancholy, despair, reduced vitality, and impaired daily functioning.¹ This ailment is not only viewed as an individual illness but also as a societal and health concern with far-reaching consequences, such as disability and heightened mortality rates. The World Health Organization reports that over 350 million individuals globally are affected by depression, with projections indicating it will become the second most common mental illness after cardiovascular disease by 2030.² Research indicates that women experience depression at nearly twice the rate of men³, underscoring the necessity for particular focus on this demographic. Presently, antidepressant medications are a primary treatment approach for depression. However, their efficacy is limited by adverse effects, high costs, potential for dependence, and patient non-compliance.⁴ Furthermore, depression significantly impacts individuals' quality of life, potentially severely affecting their social, professional, and personal functioning.⁵ Consequently, identifying alternative or supplementary treatments to alleviate depressive symptoms and enhance quality of life is crucial. In this context, physical activity and exercise have emerged as effective non-pharmacological approaches to improving mental health.⁶ Studies demonstrate that exercise can help mitigate symptoms of depression and anxiety by boosting the release of neurotransmitters such as serotonin⁷, dopamine, and glutamate.⁸ Among various exercise modalities, Pilates has gained attention as an effective method for enhancing mental and physical well-being due to its emphasis on mind-body connection, balance improvement, flexibility, and core muscle strengthening.⁹ However, research findings on Pilates' effects on depression are inconsistent, necessitating further investigation in this area. Contemporary Pilates practices can be categorized into two main schools: the repertory approach and modern Pilates.¹⁰ The repertory approach closely adheres to the early training methods outlined by Pilates himself and later by Friedman and Eisen. This traditional method employs exercise sequences and fixed

repetitions that can be adapted for different body types or issues. These sequences are consistently performed while maintaining abdominal and postural control. Particular emphasis is placed on the transitions between exercises and the fluidity of movements. Notably, Pilates drew inspiration from feline movements in developing the exercise sequence. Conversely, modern Pilates incorporates elements from other fitness or spiritual practices, such as yoga, to maximize physical and mental benefits and integrate learned concepts into daily life.¹¹ Although modern Pilates encompasses various styles, they all fall under one of two categories: mat Pilates or reformer Pilates. The initial approach necessitates only a mat, utilizing body weight as the sole form of resistance. The latter employs a movable platform with adjustable resistance springs.¹²

Considering that most research has employed a repertory technique, this study opted for a contemporary method to enhance effectiveness. Legnani, Francesca, et al.¹³ conducted a thorough analysis of research in their review titled *Is Pilates effective in improving depressive disorders?* The study samples examined in this review exhibit significant diversity in various clinical aspects that potentially impact the presence and severity of depressive symptoms, including sex¹⁴, chronological age¹⁵, the existence of medical comorbidities¹⁶, and perinatal and premenopausal stages.¹⁷ Researchers investigated Pilates' efficacy on depressive symptoms in various groups: healthy young adults¹⁸, individuals susceptible to depressive conditions, such as caregivers of frail persons¹⁹, adolescents with Internet addiction²⁰, menopausal women²¹, and elderly individuals.²² The study found that variations in the target population also affected the implementation of Pilates sequences.²³ While some sessions utilized facilitators or adhered to a strict exercise sequence, others implemented the standard Mat-Pilates sequence.²⁴ Additionally, certain studies employed certified Pilates instructors²⁵, while others relied on health professionals and physiotherapists.¹⁹ For instance, Alizadeh et al.²⁶ demonstrated that Pilates exercises could aid in treating depression and improving body composition in women with type 2 diabetes using the classical

method. When interpreting study results, additional factors to consider include: (1) limited sample sizes in some studies; (2) varied instruments used to evaluate the presence and severity of depressive disorders (sometimes specific to particular populations like pregnant women or the elderly); (3) trials conducted in different countries, where cultural context or mental health service organization may have influenced depressive disorder progression; (4) some studies were conducted during the COVID pandemic, which significantly impacted the mental health of both the general population and health professionals.

The researchers proposed that subsequent studies should explore developing a series of exercises aimed at alleviating depressive symptoms, potentially incorporating assistive tools like bands for specific groups, as suggested by Pilates instructors. Future research should address whether (1) this method is suitable for patients with varying degrees of depression, (2) what benefits it provides compared to other exercise forms, and (3) if it can be tailored into a set of targeted exercises for individuals with major depressive disorders. Building on previous research recommendations, including those mentioned in the meta-analysis by Legnani, Francesca et al.¹³ this study was conducted to evaluate the impact of an eight-week Pilates program on depression, anxiety, and quality of life in women with severe depression. The study's novelty lies in several aspects: Firstly, it focuses on severely depressed housewives, a demographic requiring particular attention due to high depression rates. Secondly, it concurrently examines Pilates' effects on depression, anxiety, and quality of life, offering a more comprehensive understanding of the exercise's benefits. Thirdly, it employs a structured, long-term exercise regimen (eight weeks), allowing for a more precise assessment of Pilates' effects. Lastly, given the rising prevalence of depression and the need for effective, low-risk treatments, this research may contribute to identifying new strategies for enhancing the mental health and life quality of depressed women. The study's outcomes could inform the development of treatment programs based on physical activity and mind-body exercises like Pilates, potentially advancing current depression treatment methods.

METHODS

Participants and study design

A randomized controlled trial (RCT) examined the impact of a Pilates-based exercise program on quality of life, anxiety, and depression among women in Iran. The study was registered at the Clinical Trials University of Qom. Participant recruitment began in June 2024 through email and phone communication with the association of depressed women in Qom, Iran. This study was approved by the Research Ethics Committee of the University of Qom (approval code: IR.QOM.REC.1401.029; approval date: April 10, 2023). The study was conducted in accordance with the Declaration of Helsinki, good clinical practices, and relevant laws and regulations. All participants provided written informed consent before inclusion in the study.

Initially, 120 women were contacted, with 60 meeting the eligibility requirements and agreeing to participate. Inclusion criteria required participants to be at least 50 years old, not regular Pilates practitioners (defined as three sessions per week for a minimum of six weeks in the previous year), and capable of comprehending the study's instructions, programs, and protocols. Exclusion criteria encompassed conditions that precluded exercise participation, such as psychiatric or neurological disorders, systemic diseases (including diabetes mellitus, cancer, or heart disease), skeletal conditions, or current enrollment in another training program.

Sample size calculation

G*Power software (latest ver. 3.1.9.7; Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany) was utilized to determine the sample size. The calculation was based on data reported by Chen et al., using the BDI total score as the dependent variable. To achieve a statistically significant difference with 0.80 power and a 95% significance level, while accounting for a 1.92% dropout rate, 30 participants were required for each group.

Procedures

The study participants were divided equally into a Pilates group (PG) and a control group (CG) using a computer-generated randomization process. Group assignments were securely stored in sealed, opaque envelopes at a locked location, to be opened by an

independent party not involved in participant selection, result evaluation, or treatment. Thirty women were allocated to each group. A flow chart of participants, following the CONSORT Statement Extension for non-pharmacological randomized controlled trials, is shown in Figure 1. An independent assessor, unaware of group allocation and intervention, recorded measurements before randomization (pre-intervention) and immediately after the intervention period (post-intervention). PG participants attended three-hour-long Pilates sessions weekly for eight weeks. Each session consisted of a 10-minute warm-up, 35 minutes of primary Pilates exercises, and a 15-minute cool-down. The intervention was conducted at the same local sports center under the guidance of a qualified instructor. The initial week focused on familiarizing participants with proper movement execution, the powerhouse (abdominal, paravertebral, and pelvic floor muscles), and Pilates principles. The first six sessions involved seated exercises, followed by progressive intensity standing exercises for strengthening and stretching (10 repetitions per session) from weeks 3-6. In the final two weeks, participants performed mat exercises using accessories (elastic bands, magic circles, and fitballs) to enhance muscle strength, endurance, and flexibility. Participants missing more than five sessions during the eight-week intervention were excluded. CG participants maintained their regular routines, received guidelines promoting physical activity, and were advised against joining other exercise programs. They were contacted periodically by phone during the intervention period. Exclusion criteria for CG participants included missing more than five sessions or more than three consecutive sessions throughout the twelve-week intervention.

Regarding the procedures for the control group, the participants were explicitly instructed to maintain their usual daily routines and to refrain from joining any other structured exercise programs for the duration of the study. To ensure adherence to this protocol and to monitor their status, they were contacted periodically via telephone follow-ups throughout the eight-week intervention period. This standard approach in randomized controlled trials, which deliberately avoids providing structured sessions to the control group, allows for a valid assessment of the specific effect of the

Pilates intervention compared to a baseline state of no additional treatment. The rationale for not holding in-person sessions was to create a clear contrast with the experimental group, and the periodic phone monitoring provided a controlled and acceptable framework to verify compliance and maintain contact without introducing the specific intervention being tested.

The flow diagram of participants shows that out of 120 women screened, 60 were eligible and randomly assigned to either the control or experimental group. Each group consisted of 30 participants. Throughout the study period, participant retention was high. In the Pilates group, no participants dropped out, and all attendees participated in at least 91.6% of the scheduled sessions. Similarly, the control group also maintained full retention with no dropouts, and all participants adhered to the study protocol by maintaining their usual routines and avoiding other structured exercise programs. No injuries or adverse effects were reported during the study.

Outcomes Measures

Beck Anxiety Questionnaire (BAQ)

In order to assess Anxiety, the Beck Anxiety Questionnaire (BAQ) was used. The Anxiety Questionnaire, created by Beck, Epstein, Brown, and Steer in 1988, is a self-report instrument consisting of 21 questions. It evaluates the intensity of anxiety experienced in the previous week using a 4-point Likert scale, ranging from zero (never) to three (very severe). The questionnaire's total score spans from 0 to 63, with scores exceeding 30 indicating anxiety presence. Beck et al. reported the scale's internal consistency as 0.94, its 11-day test-retest reliability as 0.67, and item correlations between 0.30 and 0.76.²⁷ Kaviani et al.²⁸ applied this scale to the Iranian population, reporting a Cronbach's alpha coefficient of 0.92 and a test-retest reliability coefficient of 0.83.

Beck Depression Inventory (BDI)

The Beck Depression Inventory, initially developed by Aaron T. Beck in the 1960s, assesses depression levels in adolescents and adults. Revised in 1971 and published in 1978, this 21-item questionnaire offers four response options for each statement, ranging from zero (never) to three (very severe). Respondents select the option that best describes their feelings over the past week. The inventory

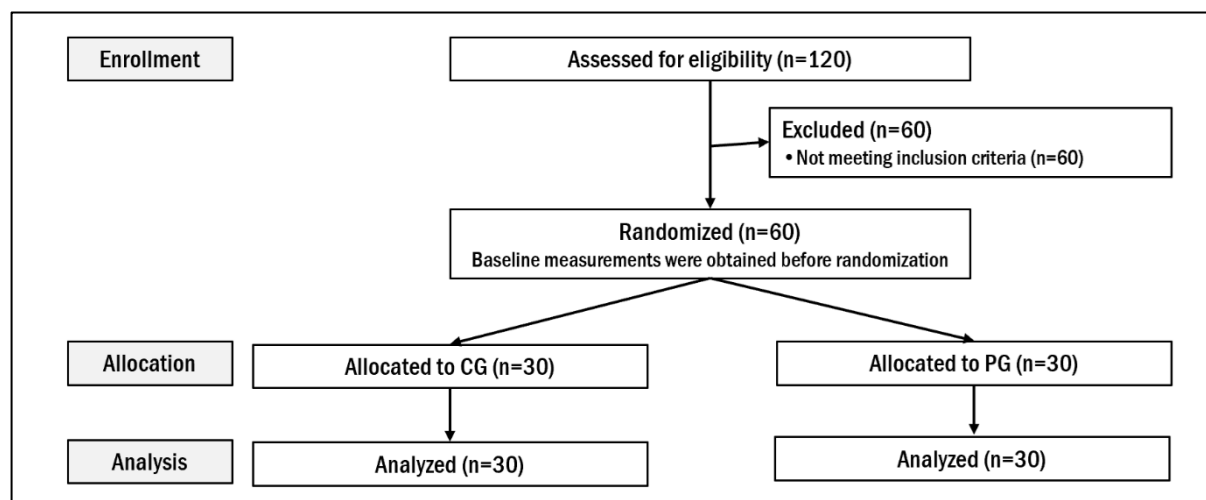


Figure 1. Flow diagram of study design.

comprises 15 items addressing psychological symptoms and 6 items focusing on physical symptoms. The total depression score, calculated by summing all item scores, ranges from 0 to 63. Scores of 0-9 indicate no depression, 10-16 suggest mild depression, 17-29 point to moderate depression, and scores above 30 signify severe depression. Mark, Mendelsohn, and Warbaugh examined the questionnaire's validity and reliability in 1979 and 1986, respectively. A recent study at Tehran University of Medical Sciences, Roozbeh Hospital, yielded a validity of 0.70 and a reliability of 0.77 for this test.²⁹

Short Form Quality of Life Questionnaire (SF-36)

Health-related quality of life was evaluated using the Short Form-36 (SF-36) Health Survey, a robust and widely utilized self-report instrument that provides a multidimensional assessment of an individual's health status. This comprehensive tool comprises thirty-six items that are systematically aggregated into eight distinct subscales, each measuring a specific aspect of health. These subscales include Physical Functioning, which examines limitations in physical activities; Role-Physical, addressing problems with work or daily activities due to physical health; Bodily Pain, assessing the intensity of pain and its interference with normal work; and General Health, capturing personal evaluations of overall health and susceptibility to illness. The instrument further measures Vitality, reflecting levels of energy and fatigue; Social Functioning,

determining the extent to which physical or emotional problems interfere with social activities; Role-Emotional, focusing on problems with work or daily activities due to emotional problems; and Mental Health, which encompasses general psychological distress and well-being. For this study, these eight subscales were computationally summarized into two primary, higher-order components: the Physical Component Summary (PCS) and the Mental Component Summary (MCS), which provide a holistic view of physical and mental health-related quality of life, respectively. We employed the officially validated Persian version of the SF-36, which has previously demonstrated excellent reliability with Cronbach's alpha coefficients ranging from 0.88 to 0.95 across its various subscales. Montazeri et al. standardized this tool in Iran, reporting Cronbach's alpha values between 0.88 and 0.95.³⁰ Numerous studies, such as Kataoka et al.³¹ have employed the SF-36 questionnaire to measure quality of life and depression. All scores were calculated and transformed according to the standard scoring protocol, where higher values consistently indicate a more favorable health state. This instrument was administered to all participants both at the baseline and immediately following the conclusion of the intervention period to accurately capture any changes.

Statistical analysis

The SPSS statistical software, version 27.0 (SPSS, Inc., Chicago, IL, USA), was utilized for conducting statistical analyses. Calculations

were made for the mean values, standard deviations, number of cases, and percentage of total for each variable of interest. To examine differences between the two study groups at baseline, Student's *t*-test for independent samples and the statistical chi-squared test were employed. The potential associations of education, marital status, occupation, age, BMI, anxiety, and depression with quality of life were investigated using univariate analysis of variance (ANOVA) and Pearson's correlation coefficient. Variables showing significant associations were subsequently included in the analysis of covariance (ANCOVA). The independent variables consisted of group (PG vs CG) and measurement time, while quality of life, depression, and anxiety served as dependent variables. Each dependent variable underwent separate analysis. When a statistically significant Group $\times$ Time interaction was observed, Student's *t*-test for unpaired or paired data was applied. Statistical significance was set at a *p*-value below 0.05. Cohen's *d* (*d*) was used to calculate intergroup effect sizes. Effect sizes were categorized as small (≤ 0.2), medium (0.2–0.5), or large (≥ 0.8).

RESULTS

Table 1 displays the baseline characteristics of participants and the dependent outcome measures. Statistical analysis showed no significant differences between the two study groups. Participants demonstrated high adherence, with all women attending at least 91.6% of the sessions. Throughout the intervention period, no injuries or negative effects were reported or observed among the participants.

Quality of life

Significant improvements were observed in the PG for both physical and mental health domains of the SF-36 ($p < 0.001$). The CG showed no significant changes (Figure 2).

Prior to conducting the primary parametric analyses, the assumption of normality for all continuous outcome variables was assessed using the Shapiro-Wilk test. This test was performed on the data from both the Pilates group (PG) and the control group (CG) at baseline. The results indicated that the data for all key variables did not significantly deviate

from a normal distribution. Specifically, the Shapiro-Wilk test statistics and corresponding *p*-values were as follows: for the Beck Depression Inventory (BDI) scores, $W = 0.97$, $p = 0.42$ in the PG and $W = 0.96$, $p = 0.38$ in the CG; for the Beck Anxiety Inventory (BAI) scores, $W = 0.98$, $p = 0.61$ in the PG and $W = 0.95$, $p = 0.21$ in the CG; for the SF-36 Physical Component Summary (PCS), $W = 0.96$, $p = 0.35$ in the PG and $W = 0.97$, $p = 0.48$ in the CG; and for the SF-36

Mental Component Summary (MCS), $W = 0.97$, $p = 0.45$ in the PG and $W = 0.96$, $p = 0.33$ in the CG. With all *p*-values exceeding the 0.05 significance threshold, the null hypothesis of normal distribution was not rejected for any variable in either group. This confirmation of normality, coupled with the adequate sample size, justified the subsequent use of parametric tests, including Analysis of Variance (ANOVA) to robustly evaluate the intervention's effects.

Analysis of the quality-of-life data, as measured by the SF-36, revealed a significant interaction effect between group and time for both physical and mental health components. In the Pilates group, a substantial and statistically significant improvement was observed in the physical health score, which increased from 175.25 at pre-intervention to 222.00 at post-intervention ($p < 0.001$). Conversely, in the control group, the physical health score remained virtually unchanged, from 178.51 to 177.56, a difference that was not statistically significant. This clear disparity in response underscores the specific effect of the Pilates intervention. A similar pattern was found for the mental health component. The Pilates group demonstrated a significant increase from 160.97 to 204.67 ($p = 0.002$), whereas the control group showed a slight, non-significant decrease from 166.93 to 161.60. These results confirm that the eight-week Pilates program was effective in significantly enhancing both the physical and mental dimensions of quality of life in the experimental group, while the control group, as expected, exhibited no meaningful change.

Anxiety

While the PG demonstrated a reduction in anxiety scores, the difference was not statistically significant ($p = 0.051$). However, a significant inverse relationship was found between anxiety and quality of life.

Depression

The PG showed a significant reduction in depression scores compared to the CG ($p=0.001$). A direct correlation was observed between depression and anxiety (Figure 3).

The results of the between-group and within-group comparison of anxiety (BAQ) and depression (BDI) scores showed that in the experimental group, anxiety scores decreased from 17.80 at pre-intervention to 9.90 at post-intervention ($p < 0.001$). In the control group, anxiety scores decreased from 20.70 at pre-intervention to 19.00 at post-intervention ($p < 0.001$). A significant difference was observed between the two groups at post-intervention ($p < 0.001$). For depression, scores in the experimental group decreased from 20.30 at pre-intervention to 10.60 at post-intervention ($p < 0.001$). In the control group, depression scores decreased from 21.20 at pre-intervention to 19.80 at post-intervention ($p < 0.001$). A significant difference was observed between the two groups at post-intervention ($p = 0.005$).

At the beginning of the study, the demographic and clinical characteristics of participants in both the control and experimental groups were examined (Table 1). The mean age of participants in the control group was 50.12 years ($SD = 5.8$), while in the experimental group, it was 50.38 years ($SD = 6.93$). No significant difference was observed between the two groups in terms of age ($P = 0.656$). The mean height in the control group was 165.10 cm ($SD = 6.77$), and in the experimental group, it was 163.28 cm ($SD = 8.32$), with no significant difference between the groups ($p = 0.723$). The mean weight in the control group was 66.10 kg ($SD = 5.21$), and in the experimental group, it was 64.01 kg ($SD = 8.15$), with no significant difference between the groups ($p = 0.722$). The Body Mass Index (BMI) in the control group was 24.58 ($SD = 6.61$), and in the experimental group, it was 24.15 ($SD = 3.10$), with no significant difference between the groups ($p = 0.520$).

Regarding quality-of-life scores (SF-36), the mean score in the control group was 172.72 ($SD = 32.55$), and in the experimental group, it was 168.11 ($SD = 18.36$), with no significant difference between the groups ($p = 0.682$). Depression scores (BDI) in the control group were 21.20 ($SD = 9.55$), and in the experimental

group, they were 20.30 ($SD = 3.46$), with no significant difference between the groups ($p = 0.836$). Anxiety scores (BAQ) in the control group were 20.70 ($SD = 12.65$), and in the experimental group, they were 17.80 ($SD = 6.06$), with no significant difference between the groups ($p = 0.724$).

The results regarding the effects of Pilates training on participants' quality of life in both the control and experimental groups were analyzed (Table 2). In the experimental group, depression scores (BDI) decreased from 20.30 at pre-intervention to 10.60 at post-intervention, which was statistically significant ($p = 0.001$). In the control group, depression scores decreased from 21.20 at pre-intervention to 19.80 at post-intervention, but this reduction was not statistically significant. The group $\times$ time interaction effect on depression was significant ($F = 54.97$, $p = 0.001$).

For anxiety (BAQ), scores in the experimental group decreased from 17.80 at pre-intervention to 9.90 at post-intervention, but this reduction was not statistically significant ($p = 0.050$). In the control group, anxiety scores decreased from 20.70 at pre-intervention to 19.00 at post-intervention, but this reduction was also not statistically significant. The group $\times$ time interaction effect on anxiety was not significant ($F = 4.39$, $p = 0.050$).

Regarding quality of life (SF-36), physical health scores in the experimental group increased from 175.25 at pre-intervention to 222.00 at post-intervention, which was statistically significant ($p = 0.001$). In the control group, physical health scores changed from 178.51 at pre-intervention to 177.56 at post-intervention, but this change was not statistically significant. The group $\times$ time interaction effect on physical health was significant ($F = 91.24$, $p = 0.001$).

Mental health scores in the experimental group increased from 160.97 at pre-intervention to 204.67 at post-intervention, which was statistically significant ($p = 0.002$). In the control group, mental health scores decreased from 166.93 at pre-intervention to 161.60 at post-intervention, but this reduction was not statistically significant. The group $\times$ time interaction effect on mental health was significant ($F = 13.32$, $p = 0.002$).

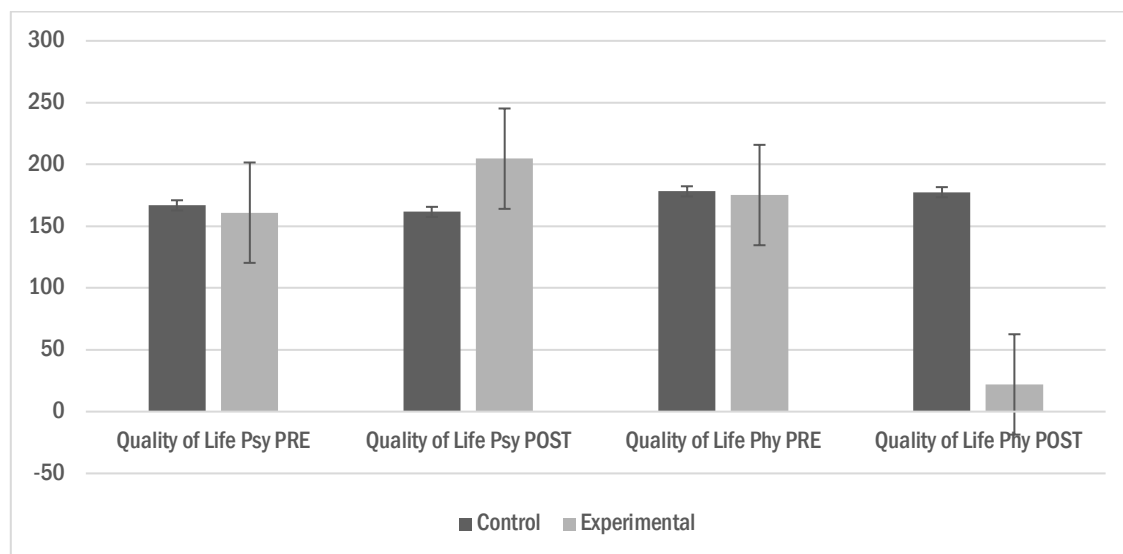


Figure 2. Between-group and within-group comparison of Quality of Life Scale Short Form 36 Items.

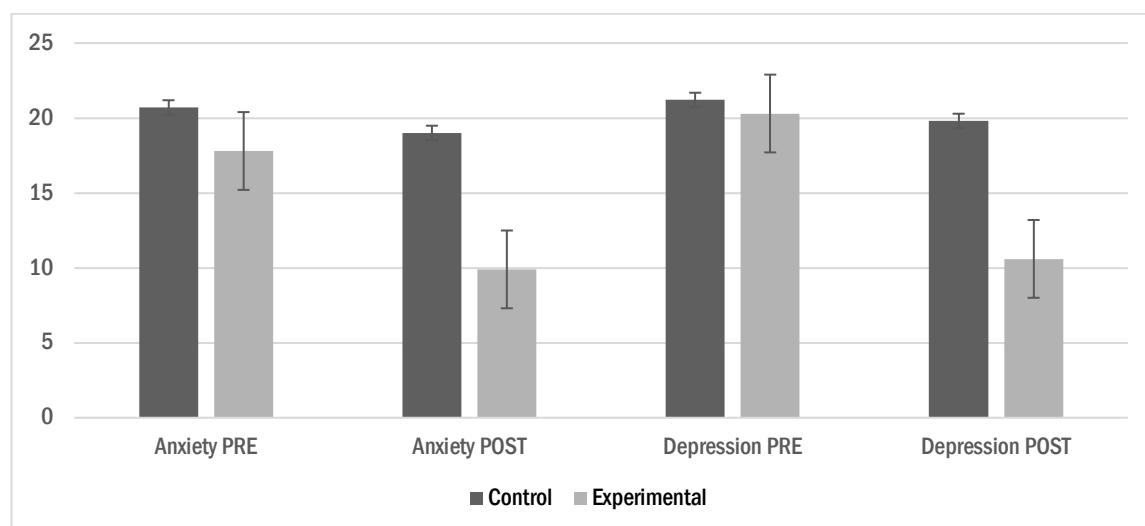


Figure 3. Between-group and within-group comparison of the Beck Anxiety Questionnaire scale and the Beck Depression Inventory Scale.

Table 1. Baseline characteristics of study participants.

	Control group (n=20)	Experimental group (n=20)	p
	Mean±SD	Mean±SD	
Age (years)	50.12±5.8	50.38±6.93	0.656
Height (cm)	165.10±6.77	163.28±8.32	0.723
Weight (Kg)	66.10±5.21	64.01±8.15	0.722
Body Mass Index	24.58±6.61	24.15±3.10	0.520
SF-36 (Quality of Life Scale)	172.72±32.55	168.11±18.36	0.682
Beck Depression Inventory (BDI)	21.20±9.55	20.30±3.46	0.836
Beck Anxiety Questionnaire (BAQ)	20.70±12.65	17.80±6.06	0.724

Table 2. Effects of Pilates training on quality of life assessed by SF-36.

	Preintervention		Postintervention							
	CG	PG	CG	PG	Group			Group x time		
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	F	p	η ²	F	p	η ²
Depression	21.2±9.6	20.3±3.5	19.8±8.9	10.6±4.32	54.97	0.001	0.746	29.03	0.001	0.631
Anxiety	20.7±12.7	17.8±6.1	19.0±12.0	9.9±7.0	13.29	0.002	0.439	4.39	0.050	0.405
QoL-Physical	178.5±46.8	175.3±35.5	177.6±47.3	222.0±29.7	91.24	0.001	0.843	43.08	0.001	0.717
QoL-Psychological	166.9±18.3	161.0±19.3	161.6±16.4	204.7±42.7	5.30	0.034	0.238	13.32	0.002	0.439

CG: Control Group. PG: Pilates Group. QoL: Quality of Life.

DISCUSSION

The present study aimed to assess the effects of an eight-week Pilates intervention on quality of life, anxiety, and depression in women aged over 50 years and older. The key findings showed an improvement in quality of life, as well as a decrease in depression, anxiety, after Pilates exercises. These results have important clinical implications for this population, not only concerning the improvements yielded by our intervention, but also due to the well-known benefits of physical exercise on several aspects of mental and physical health. These were reinforced by the high attendance rate of participants.

Studies have demonstrated that Pilates can alleviate depression symptoms in women through various physiological mechanisms. One key benefit is the enhancement of neuroplasticity, which bolsters the brain's adaptability and reorganization capabilities. These neurological changes can contribute to improved brain function in individuals suffering from depression.¹ Such alterations not only enhance mood but also increase the brain's adaptability and structural modifications.³² By promoting neuroplasticity, Pilates exercises may aid in restoring normal brain function in depressed individuals. Moreover, aerobic activities like Pilates boost the production of mood-regulating neurotransmitters such as serotonin and endorphins.³³ The structured nature of Pilates also provides women with a sense of achievement and competence, which is particularly advantageous for those facing social and economic challenges.³⁴ This feeling of control and empowerment can help counteract

the helplessness often associated with depression. Consequently, the findings indicate that Pilates could serve as an effective intervention for reducing depression in women.

The high adherence and retention rates observed in this study strengthen the validity of our findings. The fact that all participants in the Pilates group attended the vast majority of sessions (exceeding 91.6%) indicates strong compliance with the intervention, suggesting that the prescribed Pilates program was feasible and well-tolerated. Furthermore, the complete retention of all participants in the control group, coupled with their successful adherence to maintaining their usual routines without initiating other exercises, minimizes the risk of attrition bias and provides a robust comparative baseline. This high level of protocol adherence in both groups allows for greater confidence in attributing the significant improvements in depression and quality of life specifically to the Pilates intervention.

While Pilates exercises did not directly impact anxiety levels in depressed women, research suggests that they can enhance quality of life by promoting relaxation and stress reduction.³⁵ The emphasis on breathing and mindfulness techniques in Pilates can assist women in managing their emotions, thereby alleviating stress and anxiety. Additionally, the social aspect of participating in group classes can help mitigate feelings of isolation and strengthen social support networks.

The inverse relationship between anxiety and quality of life implies that reducing anxiety may lead to improved overall well-being.³⁶ These social interactions can be particularly beneficial for women under social and economic pressure, potentially enhancing emotional well-being and

reducing anxiety. Therefore, incorporating anxiety management strategies alongside physical exercise may contribute to improving both mental and physical health in depressed women. Research has shown that individuals with depression and anxiety often experience a diminished quality of life.³⁷ Pilates, as a structured form of exercise, has the potential to improve both the physical and mental health of depressed women, thereby enhancing their overall quality of life.³⁸ Improvements in physical health indicators, such as body composition, fitness, and cardiovascular health, can lead to increased self-esteem and a more positive body image.³⁹ These physical health enhancements can, in turn, positively impact mental health and contribute to an improved quality of life.

The findings of this randomized controlled trial demonstrate that an eight-week Pilates program is an effective non-pharmacological intervention for improving health-related quality of life (HRQoL) and alleviating depressive symptoms in women over 50 with depression. While the significant improvement in the overall Physical (PCS) and Mental (MCS) Component Summaries of the SF-36 is a key finding, a deeper discussion of the specific subparameters that constitute these scores provides a more nuanced understanding of how Pilates conferred its benefits.

The significant enhancement in the PCS can be largely attributed to improvements in its core subscales: Physical Functioning (PF), Role-Physical (RP), and Bodily Pain (BP). The Pilates method, with its emphasis on core strength, stability, flexibility, and controlled whole-body movements, directly targets the domains measured by these subscales. Participants likely experienced improved muscular strength and joint mobility, which would reduce limitations in performing daily physical activities (PF). Furthermore, the reduction in physical limitations would naturally lead to fewer problems with work or other regular daily roles (RP). The focus on proper alignment and balanced muscle development in Pilates is also a well-known therapeutic approach for managing musculoskeletal pain, which aligns with the observed improvement in the BP subscale, where participants likely reported less pain and less pain-related interference in their lives.

Regarding the significant improvement in the MCS, the subscales of Vitality (VT) and Mental Health (MH) are of particular interest. The VT subscale, which measures energy and fatigue, showed marked improvement. This can be explained by the energizing effect of regular physical activity and the emphasis on mindful breathing in Pilates, which is known to combat feelings of tiredness and exhaustion common in depression. The improvement in the MH subscale, encompassing general psychological well-being and symptoms of depression and anxiety, directly correlates with the significant reduction in BDI scores. This suggests that the mind-body connection central to Pilates—promoting mindfulness, body awareness, and a sense of accomplishment—fostered improved mental health. While the Social Functioning (SF) and Role-Emotional (RE) subscales were not individually reported, their contribution to the MCS is critical. The group-based nature of the intervention likely provided a source of social support, reducing feelings of isolation and improving social interactions (SF). Concurrently, the reduction in depressive symptoms would logically lead to fewer limitations in daily activities due to emotional problems (RE).

The lack of significant change in the control group across all SF-36 subparameters underscores that the observed benefits were a direct result of the Pilates intervention and not due to the passage of time or other external factors. This stark contrast reinforces the efficacy of the program.

In conclusion, the therapeutic benefits of Pilates extend beyond a general sense of well-being. Our findings suggest that it produces a multifaceted improvement in HRQoL by specifically enhancing physical capabilities, reducing bodily pain, increasing vitality, and improving mental and emotional states. This detailed profile of improvement supports the use of Pilates as a holistic, complementary therapy in managing depression and its profound impact on daily life. Future research should aim to report on all eight SF-36 subscales individually to build an even more precise picture of the intervention's impact.

Limitations

This research had certain constraints. The study population was restricted to women aged over 50 years, potentially overlooking the effects

of age, physiological status, psychological factors, and other variables. Additionally, the inability to fully control participants' living conditions, nutrition, and habits outside the study period may have influenced the results. Consequently, future studies should examine larger and more diverse samples, evaluating the physical and psychological effects of exercise on various age groups and genders. This approach can contribute to a better understanding of how Pilates and other physical activities impact mental health.

Conclusion

The study's outcomes demonstrate that engaging in Pilates exercises has a substantial and beneficial impact on depression and life quality among women experiencing depression. These discoveries underscore the crucial role of physical activity in addressing depression and enhancing the well-being of depressed women, potentially serving as an effective treatment approach. Moreover, the social and supportive aspects of Pilates may contribute to strengthening relationships and alleviating feelings of isolation in women suffering from depression and anxiety.

Based on these findings, Pilates exercises can be recommended as a complementary treatment alongside pharmacological and psychotherapy interventions for women with depression. Health and medical facilities should consider offering Pilates as a treatment option to support the mental health and quality of life of depressed patients. This study helps mental health professionals and fitness instructors design effective exercise programs for specific patient groups.

Future research should aim to elucidate the specific mechanisms involved in Pilates and explore the long-term effects of regular practice on mental well-being. Furthermore, comparing the effects of Pilates to other forms of exercise may help identify optimal treatments for improving quality of life and mental health in women with depression. Subsequent research should also investigate the long-term effects and specific mechanisms of Pilates in enhancing mental health to gain a more comprehensive understanding of this exercise modality as a therapeutic intervention.

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