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RESEARCH ARTICLE

The Effect of Eight Weeks of Pilates Exercises on Anthropometric Indices and Subjective Well-being in Obese Middle-aged Women

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Abstract:

Background:

Exercise is one of the most effective means of enhancing subjective well-being, preventing obesity, and maintaining good health.

Aim:

This study aimed to investigate the impact of eight weeks of Pilates training on anthropometric indices and subjective well-being in obese middle-aged women.

Methods:

In this quasi-experimental study, 40 eligible obese middle-aged women of Khaf Fitness Plus Sports Club were voluntarily recruited and randomly assigned to Pilates and control groups. The Pilates group participated in eight weeks of Pilates exercises performed three times weekly. The subjective well-being survey and a checklist of anthropometric indices were completed for all individuals 24 hours before and 72 hours after the intervention. Data were analyzed in SPSS-15 statistical software using Kolmogorov-Smirnov, independent t-test, paired t-test, chi-square, and Fisher exact tests. The significance level was set at $p < 0.05$.

Results:

After the intervention, the experimental group had significantly lower mean weight, body mass index, and waist-to-hip ratio than the control group ($p < 0.05$). The mean scores of emotional, psychological, and social well-being in the experimental group increased significantly after the intervention compared to baseline ($p < 0.01$).

Conclusion:

The results reveal that eight weeks of Pilates exercises significantly reduce anthropometric indices and increase subjective well-being dimensions (emotional, psychological, and social well-being) in obese middle-aged women.

Keywords: Pilates exercise, Subjective well-being, Obesity, Women, Middle-aged, Anthropometric indices.

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1. INTRODUCTION

Obesity is a common public health issue whose rapid prevalence is escalating into a major health concern worldwide [1, 2]. The World Health Organization (WHO) defines obesity as the accumulation of excess fat in the body, asserting that its prevalence is rapidly increasing globally [3]. Obesity is more prevalent in women (particularly in middle-aged women) than in men [3, 4].

Obesity and overweight gain are the fifth leading cause of mortality worldwide. Medical sources underline that obesity and weight gain in adulthood are major risk factors for several diseases, including type 2 diabetes, coronary heart disease, hypertension, gallbladder stone, sleep apnea, osteoarthritis, hyperuricemia, certain malignancies, and even depression [5, 6].

Obesity can adversely affect a person's ability to have an

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active and vibrant life. In the last decade, the prevalence of obesity-related disabilities has grown, and obesity has become a risk factor for disability in people's lives. Obesity and its medical complications can impair a person's capacity to live an active and successful life [5].

Obese persons cannot live a fully active life due to the harmful effects of obesity on their physical and psychological performance [7, 8]. Obesity disturbs a person's social, physiological, and psychological facets, diminishes physical and mental health, and exacerbates functional limitations [8].

The effects of obesity on physical and mental health are extensive. Numerous studies have demonstrated the correlation between increased BMI and deteriorating physical and mental health, emphasizing that obesity can cause disorders in various dimensions of life, including physical function, general distress, sexual function, self-confidence, and occupation [9, 10].

Physical health and the sense of well-being deteriorate dramatically with increased weight and obesity. Moreover, among obese adults without chronic physical disease, the sensation of physical well-being also declines [11].

Some studies also suggest that the relationship between obesity and various dimensions of physical and mental health in women is stronger than in men, such that obese women have lower levels of physical and mental health than obese men [12, 13].

As a component of mental health, subjective well-being affects health and longevity and is a function of one's pleasure in the face of unpleasant experiences. Subjective well-being is the ability to recognize one's repertoire of talents and is derived from an equilibrium between positive and negative emotions, life satisfaction, and occupational and family satisfaction. There are two components to subjective well-being: cognitive and emotional. While the cognitive dimension is defined as evaluating one's level of life satisfaction, emotional well-being is characterized by high levels of positive emotion and low levels of negative emotion. On the other hand, psychological well-being affects all aspects of human behavior and typically comprises physical and mental health, development in skills and education, social competence, and the development of positive social relationships [14].

The relevance of subjective well-being is growing fast owing to the advancement of positive psychology research on subjective well-being and human talents [15]. Subjective well-being is a fundamental construct in personality interpretation characterized by a positive evaluation of life and a balance of positive and negative emotions [16, 17]. Given the significance of subjective well-being in the psychological structure of human life, its promotion has been the objective of numerous therapeutic studies in clinical and non-clinical settings. Examples include the efficacy of cognitive therapy on the subjective well-being of cancer patients [18] and the efficacy of subjective well-being interventions on the positive and negative emotions of housewives [19].

The results of the study by Tsung-Chin Lee *et al.* (2019) on the effect of the Pilates training program and active movements on body image, mindfulness, and self-esteem of Taiwanese female students showed that performing Pilates and active physical movements led to improvement in body image, mindfulness and self-esteem of female students in the intervention group has been [20]. Also, the results of the study by Fonseca Silva *et al.* (2021) showed that Pilates exercise can lead to the improvement of the quality of life and other indicators of body self-image [21].

People with high levels of well-being experience more positive emotions. They have an optimistic attitude to their past, present, and future, as well as those of others, and they characterize events and happenings as pleasant. Those with a low sense of well-being, on the other hand, view the incidences as undesirable and experience more negative emotions [22].

Alterations in lifestyle, including dietary and physical activity modification, are recommended for all people, especially obese people, to alleviate negative emotions and promote positive ones. In the interim, exercise is one of the essential means of achieving and sustaining health [23]. Evidence suggests that exercise enhances physical and mental health, particularly when accompanied by weight loss [24]. Pilates is a training method that has received particular attention in recent years. It is an integrative, holistic method of stretching and strengthening muscles [25] that improves deep muscles with minimal risk of injury by addressing the breathing rhythm and mental concentration [26].

Pilates exercises consist of stretching and endurance movements performed within the range of joint motions at a regulated pace with concentration and deep breathing. This workout is a novel approach to physical training that involves a combination of strength, stretching, and respiratory and muscular motions. It aims to build muscle, enhance cardiac and respiratory indices, and promote weight loss. In contrast to conventional resistance exercises, in which individual muscle groups are trained, Pilates exercises require the activation and coordination of several muscle groups [27, 28].

While there are some inconsistent research findings [29], most recent studies suggest that Pilates exercises play a vital role in enhancing physical fitness [30] and body composition [25]. Despite the abundance of data supporting the positive effects of Pilates exercises, its moderating function on anthropometric and subjective well-being indices remains poorly understood. In addition, the majority of studies in this field have involved persons with chronic diseases, whereas studies on healthy obese individuals are scarce. In addition, most current studies have been conducted in Western societies, which differ from the Iranian context in terms of lifestyle and environmental conditions. Thus, additional clinical research is required to determine the moderating effect of Pilates exercises on anthropometric indices and subjective well-being of healthy individuals. Therefore, the present study was performed to determine the effect of eight weeks of Pilates exercises on anthropometric indices and subjective well-being in obese middle-aged women.

2. MATERIALS AND METHODS

A controlled, randomized, quasi-experimental study was performed with a pretest and a posttest. Eligible middle-aged obese women from the *Fitness Plus* Sports Club in Khaf were

recruited. Inclusion criteria consisted of the age range of 31 to 49 years; body mass index (BMI) between 35 and 30 kg/m2; consent to participate in the study; absence of chronic diseases such as diabetes, hypertension, cancer, and cardiovascular, liver, kidney, thyroid diseases; non-availability of special diet; absence of antidepressants and hormones; absence of pregnancy, breastfeeding, and tobacco and alcohol use; having a normal menstrual cycle; leading a sedentary lifestyle; having the ability to participate in sports activities; and not engaging in sports for at least six months before the commencement of this study. Exclusion criteria included noncompliance with the training regimen, absence from the sports club for two consecutive sessions, and refusal to continue participating in the research. Accordingly, forty participants were included in the research. The participants were assigned randomly to two groups (control and Pilates exercise groups).

The specimen size was determined using the formula related to the size of the uncertain population and also based on previous studies at a confidence level of 95% and an error margin of ±5%. Accordingly, 40 eligible volunteers were selected through purposive sampling [31, 32]. The lottery method was used for random allocation. This method is a large block the size of the total sample size To ensure a balance in the number of people assigned to each group. For this purpose, the size of the sample size (Number 40) of the same shape card on which numbers 1 to 40 were written was placed in the same shape envelope and then in a lottery container. Then randomly remove the cards and number the first 20 cards for group A (Pilates exercise) and the next 20 cards for group B (control group) was written. In this way, a random chain of assigned numbers and groups was identified. Candidates were numbered in the order of referral date and assigned to the groups based on the written sequence.

Subjects were asked to sign consent forms and complete the health status questionnaire after being properly informed about the research design. The intervention group completed the physical activity readiness questionnaire (PAR-Q). All participants were given the required safeguards. Participants in the intervention group were advised to continue their routine nutritional diet, and subjects in the control group were advised to continue their previous lifestyle until the end of the study.

The intervention group was thoroughly instructed on the Pilates exercise program. According to the program, they engaged in Pilates exercises for eight weeks/three sessions weekly at the Fitness Plus Sports Club in Khaf. Notably, all the ethical principles of working with human subjects were considered, and the subjects were aware of all aspects of the research. Moreover, they could leave the research project whenever they wanted.

The Subjective Well-being Scale and a checklist of obesity anthropometric indices (body weight, BMI, waist circumference, pelvic circumference, hip circumference, and arm circumference) were completed for both group members 24 hours before and 72 hours after the intervention (eight weeks of Pilates exercises).

2.1. Subjective Well-being Scale

The 45-item Subjective Well-being Scale developed by Keyes and Magyar-Moe (2003) measures emotional, psychological, and social well-being.

* The first 12 items address emotional well-being on a 5-point Likert scale (1 = not at all, 2 = a little, 3 = sometimes, 4 = most of the time, 5 = all the time).

A score between 12 and 24: Low emotional well-being

A score between 24 and 36: Moderate emotional well-being

A score above 36: High emotional well-being

* The next 18 questions are related to subjective well-being, which uses a 7-point Likert scale for scoring (1 = strongly disagree, 2 = somewhat disagree, 3 = slightly disagree, 4 = I do not know, 5 = slightly agree, 6 = somewhat agree, 7 = strongly agree).

A score between 18 and 36: Low subjective well-being

A score between 36 and 72: Moderate subjective well-being

A score above 72: High subjective well-being

* The last 15 questions are related to social well-being, for which a 7-point Likert scale is used (1 = strongly disagree, 2 = somewhat disagree, 3 = slightly disagree, 4 = do not know, 5 = slightly agree, 6 = somewhat agree, 7 = very much agree).

A score between 15 and 30: Low social well-being

A score between 30 and 60: Moderate social well-being

A score above 60: High social well-being

The internal validity of the emotional well-being subscale in Keys and Magyar-Moe's study was 0.91 in the positive emotion domain and 0.78 in the negative emotion domain. The psychological and social well-being subscales received average internal validity scores of 0.4 and 0.7, respectively, and both measures' total validity scores were 0.8 or higher [33]. The validity of this scale was investigated using factor validity in their study. Moreover, confirmatory factor analysis results verified this scale's three-component structure. The test-retest reliability coefficient for this scale was 0.86 in Dost's (2004) study [34].

In Golestanibakht's study, the reliability of the subjective well-being scale and the subscales of emotional well-being, psychological well-being, and social well-being were 0.75, 0.76, 0.64, and 0.76, respectively. Additionally, Cronbach's alpha coefficients for each of the above parameters were 0.80, 0.86, 0.80, and 0.64, respectively, indicating the scale's desired internal consistency [35].

2.2. Pilates Exercise Protocol in this Study

Pilates exercises were derived from Worth [36] to compile the Pilates exercise program. A session was allocated to explain the basics of Pilates, before the commencement of the program. After the introductory session, the eight-week Pilates exercise program commenced. The program consisted of three non-consecutive sessions a week, 60 minutes in duration, for eight weeks with increasing intensity.

The training program called for 60 minutes of exercise,

beginning with a 10-minute warm-up followed by 40 minutes of exercise and a 10-minute cool-down. Pilates exercises began on a basic level and gradually incorporated advanced stretching movements, muscular endurance, balance, flexion, and neuromuscular coordination. The workouts targeted the big upper and lower torso muscles in standing, seated, and supine positions without specialized equipment. To adhere to the principle of overload, the speed and repetition of movements in each session increased relative to the previous session, beginning with 10 repetitions in the first week and progressing to 20 to 25 repetitions by the eighth week. Furthermore, the maximum heart rate equation (maximum heart rate = 220 - age) was utilized to manage exercise intensity [37]. Accordingly, exercise commenced in the first week with an intensity of 50-55 percent of maximal heart rate and increased to 75-80 percent of maximal heart rate in the eighth week (approximately 5 percent increase in exercise intensity per week) [32].

2.3. Anthropometric Evaluation in this Study

The anthropometric evaluation was derived from Teresa Garcia-Pastor Correio [38] to compile the Anthropometric evaluation program. A checklist of obesity anthropometric indices (body weight, BMI, waist circumference, pelvic circumference, hip circumference, and arm circumference) was completed for all participants 24 hours before and 72 hours after the intervention (eight weeks of Pilates exercises). Bodyweight was assessed with the subjects wearing minimum clothes and barefoot with an accuracy of 0.1 kg and their standing height with an accuracy of 0.1 cm, using a Seca digital stadiometer (model 220, made in Germany). BMI was calculated by dividing body weight (kg) by height squared (square meters). Lastly, a tape measure was used to measure the waist, hip, thigh, and arm circumferences.

SPSS 15 statistical software was employed to examine the data. Initially, the Kolmogorov-Smirnov test assessed the normality of the data distribution. Based on the distribution, independent and/or paired t-tests were performed. The demographic characteristics of the two groups were compared using the Chi-square and Fisher's exact tests. The significance level was set at $p < 0.05$.

3. RESULTS

This study included 40 obese middle-aged women divided into experimental and control groups. The groups were similar in terms of marital status, education level, occupation, and age ($p > 0.05$) (Table **1**):

The results revealed that there is no significant difference in average height between the experimental group (158.95 ± 3.83) and the control group (159.25 ± 3.18) ($p = 0.79$). Mean anthropometric indices (weight, BMI, waist-to-hip ratio, pelvic circumference, and waist circumference) in the experimental and control groups were not significantly different before the intervention ($p > 0.05$). However, the mean weight, BMI, and waist-to-pelvis ratio were significantly lower in the experimental group than in the controls after intervention ($p < 0.05$). In the experimental group, mean anthropometric indices were significantly lower after the intervention than before the intervention ($p < 0.001$). Nonetheless, in the control group, there was no significant difference in anthropometric indices before and after the intervention ($p > 0.05$). The mean changes of anthropometric indices before and after the intervention in the experimental group were significantly higher than in the control group ($p < 0.001$). In other words, it may be stated that eight weeks of Pilates exercise significantly reduces anthropometric parameters in obese middle-aged women (Table **2**).

The results showed that the mean scores of emotional, psychological, and social well-being before the intervention in the experimental and control groups were not significantly different ($p > 0.05$). After the intervention, nevertheless, the mean scores were significantly higher in the experimental group than in the control group ($p < 0.05$). In the experimental group, the mean score of emotional, psychological, and social well-being was significantly higher after the intervention than before it ($p < 0.01$). Yet, there was no significant difference in the control group's scores over time ($p > 0.05$). The mean score changes in emotional, psychological, and social well-being before and after the intervention in the experimental group were significantly higher than in the control group ($p < 0.01$). In other words, it can be concluded that eight weeks of Pilates exercise could significantly enhance subjective well-being dimensions (emotional, psychological, and social well-being) in obese middle-aged women (Table **3**).

Table 1. Comparison of demographic characteristics in experimental and control groups.

Group Variables		Experimental	Control	P-value for between-group Comparison
		Frequency (Percent)	Frequency (Percent)	
Marital Status	Single Married	6 (30) 14 (70)	5 (25) 15 (75)	0.72*
Education Level	Primary/secondary school High school diploma Bachelor's degree	4.20 6 (30) 10 (50)	8 (40) 4.20 8 (40)	0.38*
Occupation	Homemaker Healthcare employee Non-healthcare employee	11 (55) 7 (35) 2 (10)	10 (50) 7 (35) 3 (15)	1.00**
Age	Mean ± SD	38.4 ± 5.37	37.3 ± 35/23	0.57**

*: Chi-square **: Fisher's exact test ***: Independent *t*-test.

Table 2. Comparison of mean anthropometric indices in experimental and control groups and mean changes over time.

Variables	Group	Before Intervention	After Intervention	P-value Paired t-test	Before-after Changes
		Mean ± SD	Mean ± SD		Mean ± SD
Weight	Experimental	84.4 ± 35.94	75.4 ± 95.61	<0.001	-8.2 ± 45.78
	Control	81.5 ± 85.05	82.5 ± 4.00	0.11	0.0 ± 19.51
P-value independent t-test		0.12	<0.001	-	<0.001
BMI	Experimental	33.1 ± 28.42	30.1 ± 6.51	<0.001	- 3.1 ± 32.03
	Control	32.1 ± 32.66	32.1 ± 34.67	0.55	0.0 ± 13.34
P-value independent t-test		0.06	<0.001	-	<0.001
Waist-to-hip ratio	Experimental	0.00 ± 95.05	0.0 ± 91.04	<0.001	-0.0 ± 04.02
	Control	0.0 ± 96.06	0.0 ± 96.06	0.06	0.0 ± 2.01
P-value independent t-test		0.92	0.004	-	<0.001
Pelvis circumference	Experimental	111.10 ± 85.90	109.10 ± 95.62	<0.001	-1.1 ± 70.03
	Control	111.10 ± 65.94	111.11 ± 78.05	0.29	0.0 ± 13.51
P-value independent t-test		0.95	0.60	-	<0.001
Waist circumference	Experimental	106.10 ± 80.97	101.11 ± 15.26	<0.001	-6.2 ± 25.43
	Control	107.11 ± 23.78	107.11 ± 40.76	0.09	0.0 ± 10.38
P-value independent t-test		0.91	0.09	-	<0.001

Table 3. Comparison of mean scores of subjective well-being dimensions before and after intervention in experimental and control groups and separately in each group and comparison of their mean changes.

Variables	Group	Before Intervention	After Intervention	P-value Paired t-test	Before-after Changes
		Mean ± SD	Mean ± SD		Mean ± SD
Emotional well-being	Experimental	2.0 ± 80.25	3.0 ± 29.24	<0.001	0.0 ± 49.24
	Control	2.0 ± 92.27	2.0 ± 94.28	0.29	0.0 ± 2.10
P-value independent t-test		0.15	<0.001	-	<0.001
Subjective well-being	Experimental	4.0 ± 10.33	4.0 ± 70.52	<0.001	0.0 ± 60.62
	Control	3.0 ± 98.34	4.0 ± 3.74	0.74	0.0 ± 5.62
P-value independent t-test		27	0.002	-	0.008
Social well-being	Experimental	4.0 ± 6.47	4.0 ± 48.31	0.003	0.0 ± 42.56
	Control	4.0 ± 21.36	4.0 ± 24.36	0.17	0.0 ± 3.07
P-value independent t-test		0.25	0.03	-	0.003

4. DISCUSSION

This study investigated the impact of eight weeks of Pilates exercises on anthropometric indices and subjective well-being in obese middle-aged women. In contrast to other research that has merely assessed the impact of Pilates on physical parameters, this study explored the moderating effect of Pilates exercises on both physical and mental variables.

In the experimental group, the mean scores of anthropometric indices decreased significantly after the intervention compared to the baseline; however, in the control group, there was no significant change in anthropometric indices before and after the intervention. In addition, the experimental group experienced significantly greater changes in anthropometric indices over time than the control group. Accordingly, it can be concluded that eight weeks of Pilates exercises significantly reduce anthropometric parameters in obese middle-aged women.

This research finding can be explained by highlighting the structural differences between Pilates and conventional exercises. Pilates is a different form of physical fitness that combines strength, flexion, breathing, and muscular movements. The training movements of this exercise target the deepest layers of abdominal fat, and by strengthening the torso muscles (abdomen, lumbar, and lateral), it increases fat burning and muscle growth in these regions. Pilates employs a holistic approach and entails the activation and synergy of several muscle groups, unlike conventional resistance exercises where muscles are trained individually. Therefore, it can be inferred that regular Pilates workouts are connected with increased energy consumption, resulting in muscle strengthening and development, improved cardiac and respiratory function, fat loss, improved body composition, and enhanced anthropometric indices [27, 28].

This finding complies with the results of Khosravi *et al.'s* study. Their study revealed that eight weeks of Pilates exercises three times per week dramatically lowered anthropometric indices in obese women. In this semi-experimental study, 20 women with regular menstrual cycles and body mass index (30-25) were voluntarily chosen and randomly divided into two groups, Pilates and control. Pilates group trained 8 weeks, three times per week. Their study revealed the arms, abdomen, hips, thighs, weight, and body mass index after training in the Pilates group was significantly

reduced and the control group showed no significant change compared to the start of the study. Therefore Pilates exercise can affect anthropometric indexes in overweight women. [39]. Similarly, Seraj *et al.'s* study on body composition and flexion in non-athlete women found that eight weeks of Pilates exercises significantly affected fat percentage and BMI. This randomized quasi-experimental study with the pre-test and post-test design was performed on 20 inactive older women. The participants were randomly divided into experimental and control groups. The experimental group participated in the Pilates program for 8 weeks, 3 sessions per week. During this period, the control group did not participate in any training program. The studied variables in the training group were evaluated at the beginning and after 8 weeks of the program. Their study revealed that Eight weeks of Pilates training significantly increased static and dynamic balance and significantly decreased body fat percentage in older women. Therefore Pilates exercises can improve balance and reduce the percentage of body fat in older women. [40].

Contrary to the present study's findings, other research has not noticed substantial changes in anthropometric indices and body composition following Pilates exercises. M. Bergamin *et al.* (2015) investigated the effect of supervised Pilates exercise on physical performance in their study. They examined twenty-five postmenopausal women aged 59 to 66 years. Their study revealed that Pilates was effective in increasing upper body, lower body, and abdominal muscle strength. But no changes in body composition were detected. The results of this investigation also indicated that 12 weeks of Pilates is not sufficient to determine meaningful improvements n body composition [41]. Betül Sekendiz *et al.* (2007) in their study was to examine the effects of Pilates exercise on abdominal and lower back strength, abdominal muscular endurance, and posterior trunk flexibility of sedentary adult females. Randomly selected 45 sedentary academicians in a university volunteered to participate in this study. The body fat and body mass index (BMI) pre- and post-data were also assessed as secondary outcomes. Their study revealed that there was a positive effect of Modern Pilates mat exercises on abdominal and lower back muscular strength, abdominal muscular endurance, and posterior trunk flexibility in sedentary adult females even though the body weight and fat percentages did not differ significantly [42]. Among the reasons for the disparity between the findings of earlier studies and those of the present investigation are the lower intensity and number of Pilates sessions, as well as the different target populations (people with normal weight, lower average weight, and BMI of participants).

The current study's findings demonstrate that the mean scores of emotional, psychological, and social well-being in the experimental and control groups were not substantially different before the intervention. However, after the intervention, the scores were significantly higher in the experimental group than in the control group. In the experimental group, the mean scores of emotional, psychological, and social well-being were significantly higher after the intervention than before. Nonetheless, there was no significant change in the control group scores over time. The experimental group experienced considerably greater changes in emotional, psychological, and social well-being scores before and after the intervention than the control group. Thus, it may be concluded that eight weeks of Pilates training has a considerable impact on the subjective well-being (emotional, psychological, and social well-being) of obese middle-aged women.

The implications of obesity and overweight on physical and mental health can be highlighted to explain this research finding. According to research findings, there is a correlation between a higher BMI and poor physical and mental health [9, 10]. In line with this finding of the present study, the results of the study by Eda Akbaş and colleagues (2018) showed that the current Pilates exercise protocol contributes to the physical, and psychological well-being of young females in terms of anthropometric features, emotional state, fatigue, and some domains of quality of life [43]. Also, the results of Mehdi Duyan *et al.'s* study (2022), in line with this finding of the present study, showed that Pilates exercises reduce social appearance anxiety and increase psychological well-being. It can be said that when women who do regular pilates exercises develop a positive physical image, they are more at peace with themselves and increase their psychological well-being [44].

Consistent with the findings of this study, Van De Voorde *et al.* [22] and Hagner-Derengowska *et al.* [24] found that Pilates exercises contributed to rising physical and mental health and subjective well-being, particularly when accompanied by weight loss. People with a high level of well-being experience greater positive emotions, whereas those with a low level of well-being experience more negative emotions. In keeping with the current study's findings, Bahram *et al.* discovered that Pilates exercises can reduce anxiety and depression, enhance and develop mental health indicators, and increase mental and social performance in older men [45].

Our study demonstrated a significant association between anthropometric indices and subjective well-being, with scores of anthropometric indices decreasing and all components of subjective well-being (emotional, psychological, and social well-being) improving after a period of Pilates exercises in obese middle-aged women.

Similar to prior research, the present study has certain limitations. Based on its unique circumstances, the most significant constraint was the scarce availability of scientific resources and research background on subjective well-being and the impacts of Pilates exercises worldwide, particularly in Iran. Notably, this research was completed exclusively in Khaf. The findings should be generalized with care, given the significance of cultural, economic, and geographical factors in different regions and provinces of the country, as well as the effect of these variables on subjective well-being. Interpretation of findings of this nature should consider cultural, social, and economic differences. A further limitation of the present investigation was the brief duration of the experiment. It is advised that future research examine the influence of Pilates exercises on anthropometric indices and subjective well-being in various age and gender groups over a longer period and with bigger sample sizes. Consequently, doing a comparable study while assessing the outcomes of this research can serve as a guide for the development of individualized treatment plans for subjective well-being.

CONCLUSION

The current study demonstrated a significant relationship

between anthropometric indices and subjective well-being. Indeed, anthropometric indices in obese middle-aged women fell, and all aspects of subjective well-being (emotional, psychological, and social well-being) improved after a period of Pilates exercises. the Pilates exercises provided in this study are efficient and effective therapies for reducing anthropometric indices and enhancing the different dimensions of subjective well-being. Therefore, Identifying which components of subjective well-being (emotional, psychological, and social) most contributed to improving this perception would be a great leap toward a better understanding of the practice of Pilates for obese women.

LIMITATIONS OF THE STUDY

This study has limitations, including:

1. In the absence of relevant work and studies, the findings could not be easily compared with those of related research reports.

2. Lack of attention to the metabolic syndrome caused by obesity and its relationship with the research findings, which can indirectly affect the research results.

3. Failure to pay attention to the relationship between social and economic factors with the research findings, which can indirectly affect the research results.

4. The present study's findings apply to obese middle-aged women of Khaf Fitness Plus Sports Club. Therefore, there are limitations to the generalizability of the current study's findings.

5. Researchers became aware of the total adherence of participants in the diet was associated with a particular limitation.

AUTHORS' CONTRIBUTION

KH and RR devised the main concept and took part in sampling. JJ and SS analysed the data and wrote the first draft. RR wrote the final draft.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Biomedical Research Ethics Committee of Mashhad University of Medical Sciences issued the study's code of ethics (IR.MUMS.FHMPM. REC.1401.001).

HUMAN AND ANIMAL RIGHTS

No animals were used in this research. All procedures performed in studies involving human participants were in accordance with the ethical standards of institutional and/or research committees and with the 1975 Declaration of Helsinki, as revised in 2013.

CONSENT FOR PUBLICATION

All participants volunteered to participate in the study, and secondly, Keeping in mind the principles of confidentiality and secrecy, participants were assured that all information would remain confidential and that the results would be reported in a general manner.

STANDARDS OF REPORTING

STROBE guideline has been followed.

AVAILABILITY OF DATA AND MATERIALS

The data that support the findings of this study are available from the corresponding author [R.R] upon reasonable request.

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CONFLICT OF INTERESTS

The authors declare no conflict of interest, financial or otherwise.

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