Complementary Therapies in Clinical Practice 34 (2019) 35–40

Contents lists available at ScienceDirect

Complementary Therapies in Clinical Practice

journal homepage: www.elsevier.com/locate/ctcp

Pilates exercises and quality of life of patients with chronic kidney disease

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ARTICLE INFO

Keywords:
Chronic kidney diseases
Pilates exercises
Quality of life

ABSTRACT

Background and purpose: There is a need to investigate the effects of pilates exercises on the quality of life (QOL) of patients with chronic kidney diseases (CKD). The purpose of this study was to determine the effect of pilates exercises on the QOL of CKD patients.
Materials and methods: For this randomized controlled clinical trial, we enrolled 50 CKD patients. The participants were randomly assigned to experimental ($n = 25$) and control ($n = 25$) groups. Modified classical pilates exercises were performed by the experimental group three times a week over a 12-week period. The Quality of Life Short Form (KDQOL-SF) questionnaire was completed by all participants at the beginning of the trial and two months after completion of the intervention. Data analysis was conducted using Chi-square, independent *t*-test, and paired *t*-test.
Results: There were significant increases in the scores of QOL dimensions in the experimental group after the intervention ($p \leq 0.05$). Comparison of the mean differences at the beginning and two months after the study in the two groups showed that the scores related to QOL dimensions in the experimental group were significantly greater than the control group ($p \leq 0.05$).
Conclusion: The findings indicated the pilates exercises can be valuable for improvement of CKD patients' QOL.

1. Introduction

Chronic kidney diseases (CKD) lead to permanent kidney damages. These damages and their serious consequences threaten the health of the affected individuals. The incidence, prevalence, and mortality rates related to CKD and end stage renal disease (ESRD) are universally increasing [1–3]. Additionally, the number of patients with CKD is rapidly increasing in Iran. This number increased from 6% of the population in 2012 to 17% in 2015 [4]. Patients endure multiple health conditions, including decreased cardio-respiratory fitness, muscle force, and physical performance [1–3]. These conditions may contribute to emotional and social problems and functional limitations [5]. The physical, mental, and emotional problems associated with CKD, combined with therapeutic procedures and adjustments in lifestyles, such as changes in diet and medications [6], lead to a decrease in patients' quality of life (QOL) [7].

With advances in medical interventions and increasing the number of patients surviving from chronic health conditions and their lifespan, QOL is increasingly emphasized among healthcare providers for management of chronic diseases [7]. QOL is a multidimensional concept and includes subjective and objective dimensions, such as physical, emotional, social, and mental dimensions [8]. While evidence revealed that problems associated with chronic diseases and their treatments led to a decrease in QOL of patients [8–10], other studies indicated that physical activity was effective in disease prevention and management as well as improvement of QOL [9–11].

In a meta-analysis of multiple clinical trials, Cheema et al. reported that exercise increased muscular strength and QOL in CKD patients [12]. Inversely, in a systematic review, Koufaki et al. indicated that physical inactivity decreased CKD patients' physical functioning and QOL and increased their morbidity [13]. Tsai et al. (2017) indicated that regular physical training has significant effects on CKD patients' QOL [14]. Other studies also showed aerobic exercise to be effective in improving QOL and decreasing depression and anxiety in CKD patients [10,15,16].

Pilates exercises are a set of physical fitness activities that enhance body posture and flexibility through strengthening the core muscles, such as diaphragm, transversus abdominis, multifidus, and pelvic floor

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https://doi.org/10.1016/j.ctcp.2018.10.017
Received 5 April 2018; Received in revised form 27 October 2018; Accepted 28 October 2018

muscles [17]. They also enhance posture and breath coordination in combination with other movements [18]. Studies have investigated the effects of pilates exercises on patients' QOL; however, their populations were different, and the results were contradictory [19,20]. Natour et al. assessed QOL dimensions of low-back pain patients before and after pilates exercises and found that the exercises were only significant in improvement of physical functioning [19]. Other research groups also reported significant improvement of QOL with pilates interventions in patients with diabetes, hemodialysis, low back pain, and a history of stroke [15,21–25]. Using pilates exercises and walking, Kalron et al. did not find any significant improvement in QOL of multiple sclerosis women [26]. With pilates exercises, Segal et al. [27] and Shea et al. [20] as the same way did not find any significant improvement in QOL of healthy adults and stroke patients, respectively.

The National Kidney Foundation (NKF) and the Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines for clinical practice have emphasized physical activity as part of patients' routine care plan [28]. These guidelines recommend cardiovascular activities with a moderate intensity for at least 30 min most days per week. Patients with activity intolerance initiate the activities with low levels and durations and gradually may progress the levels and durations to recommended and therapeutic levels. However, despite these guidelines and current evidence, exercise is not practically recognized as part of care plans among patients and healthcare providers. Although researchers have conducted studies on the effects of pilates exercises on QOL in different groups of patients [19–26,29–31], there has been a noticable lack of studies on the effects of pilates exercises on the health of CDK patients. Considering the recent advances concerning treatment and management of chronic illnesses, disease management, and QOL of CKD patients are not satisfactory [32]. Thus, the aim of this study was to evaluate the effects of Pilates exercises on QOL in CKD patients.

2. Materials and methods

A total of 50 CKD patients were recruited in Akhavan Hospital, Kashan, Iran, from 2015 to 2016. Using the Pocock's sample size formula [33], the optimal sample size of each group was estimated to be 25 participants. According to Kanani et al. [34], d (the difference between the two mean scores) and ∂ (standard deviation) were respectively equal to 7.8 and 7, with a type I error probability of 0.05 and a power of 0.80. Participants were randomly assigned to the pilates exercises (n = 25) and control (n = 25) groups (simple allocation using www.random.org) (Fig. 1).

The participants were aged 18–65 years, were not currently participating in any other regular physical exercise program or physical activities beyond routine daily activities, had the physical ability to perform basic daily activities, and had a nephrologist's permission to practice the exercise. Based on the National Kidney Foundation's guidelines [28], the nephrologist assessed the potential participants and provided participation permission for the potential participants who were in stage II (GFR: 60–89 mL/min/1.73 m^2) or III (GFR: 30–59 mL/min/1.73 m^2) of CKD. Exclusion criteria included being a habitual pilates practitioner; detection of reduced exercise tolerance, including tachycardia, shortness of breath, and feeling too tired or weak; dialysis over the course of the study; being in the stage 1, 4, or 5 of CKD, and other concurrent clinical conditions, such as cardio-respiratory problems reported by physician and/or patients. Participants with more than one session of absence in pilates exercises were excluded from the study. Based on the inclusion and exclusion criteria, CKD patients who referred to Akhavan Hospital for nephrologist visits were assessed by the first author. Then the patients who met the inclusion and exclusion criteria and consented to participate in the study were evaluated by a nephrologist to ensure they had the ability to exercise.

2.1. Measurements

The study measures included a sociodemographic questionnaire (gender, age, marital status, job, and level of education) and the Kidney Disease Quality of Life (KDQOL-SF) instrument. The KDQOL-SF is a standard self-report instrument. The instrument was developed by Green et al., in 2001. The instrument was translated to different languages by other researchers [35]. In Iran, the KDQOL-SF was modified and translated into Persian by Pakpour et al., in 2011. Cronbach's alpha of the subscales of the Persian version of the KDQOL-SF was 0.71–0.93 [36].

The KDQOL-SF includes three main domains. The domains include (a) physical health components summary (PCS), consisting of physical functioning (10 items), role-physical (4 items), pain (2 items), and general health (5 items) subscales; (b) mental health components summary (MCS), including energy/fatigue (4 items), social functioning (2 items), role-emotional (5 items), and emotional well-being (3 items) subscales; and (c) kidney disease components summary (KDCS), consisting of symptom/problem list (12 items), effects of kidney disease (8 items), burden of kidney disease (4 items), cognitive function (4 items), work status (2 items), sexual function (2 items), quality of social interaction (3 items), sleep (4 items), social support (2 items), dialysis staff encouragement (2 items), and patient satisfaction (1 item) subscales. The total scores of QOL range from 0 to 100.

2.2. Intervention

A clinical trial study was performed with 50 patients. The participants in both groups received CKD routine care. Additionally, a 12-week modified classical pilates exercise regime was assigned to the participants in the experimental group. In the experimental group, the participants' ability to exercise was evaluated by a nephrologist prior to the intervention. Moreover, an expert in sport physiology evaluated the exercise risk for these participants and noted it to be a minor risk.

After the specialists gave their permission for exercise, a 4-h education session about exercise was provided for the experimental group's participants. The trainer, who has a pilates coaching certificate, performed a physical demonstration of the exercises and explained the execution of movements for the participants. She also explained the importance and benefits of the exercises for the chronically ill, including CKD, patients. The experimental group's participants performed exercises at 11 a.m. every Monday, Wednesday, and Friday at the hospital. The day before the exercise sessions, the first author contacted the participants to remind them of the sessions and schedule their transportation to the test facility if necessary. The sessions were initially 45 min long and were eventually increased to 70 min [15,37]. The first and second sessions lasted 45 min. In the first session, basic principles of pilates exercises were reviewed, and basic pilates movements were trained and performed. In the first and second sessions, the number of exercises began with 10 repetitions (45 min in total). In the subsequent sessions, stretching exercises (about 5 min), pilates exercises (about 50 min), and cooling down movements (about 5 min) were completed. In these sessions (sessions 3–12), the number of exercises reached 70–80 repetitions (70 min in total) [15]. Before the start of each exercise session, the trainer reviewed basic information regarding the exercise—such as isometric contraction of the transverses abdominis, pelvic floor, and multifidus muscles while exhaling via diaphragmatic breathing—with the participants. During the intervention, a modified pilates exercises protocol for chronically ill patients suggested by Marinda et al. was used [37].

During the exercise, 13 movements were performed: Bridging, Hundred, Roll Up, One Leg Circle (both ways), Rocker with closed legs, Single Straight Leg Stretch, Double Leg Stretch, Spine Stretch Forward, Single Leg Kick, Side Kick up and down, Side Kick circles, Rest position (stretch and relaxation), and Curling. Furthermore, warming up and cooling down movements were completed before and after the exercise

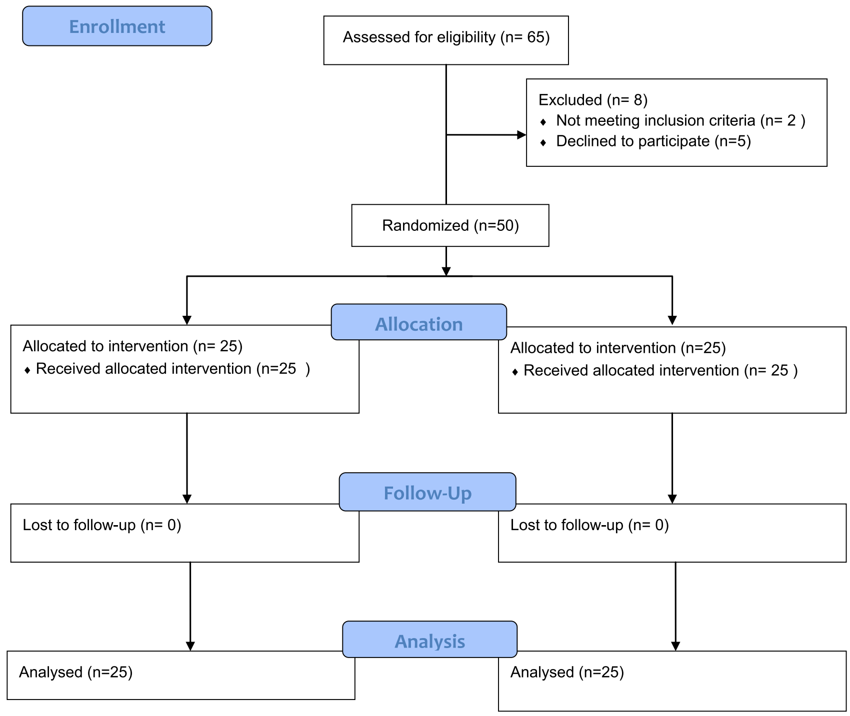

Fig. 1. CONSORT flow diagram.

[38].

The first author (who has a pilates training certificate) coached the participants in groups of three to five, to ensure the accurate execution of the movements. To avoid hypoglycemic shock and other complications in the participants, high-intensity exercises or advanced pilates were not performed. During the exercises, we monitored patients for complications, such as fatigue, dizziness, difficulty breathing, decreased alertness, numbness in hands/feet, and pain. At the end of each session, incentives (gift cards) were given to the participants. In the control group, the incentives were given after completion of the questionnaires at the beginning and the end of the study. No injury associated with the intervention occurred over the course of the study. Using the reminders, the participants attended the sessions as they were scheduled.

The participants in the two groups were contacted weekly by phone for follow-ups and further consultations. The demographic and KDQOL-SF questionnaires were completed by the participants at the beginning and two months after completion of the intervention. At the end of the study and after completion of the questionnaires, the sports professional provided educational sessions on CKD care and benefits and costs of the pilates exercises for the control group's participants using educational videos, CDs, and pamphlets. All the participants were educated. At the time of the study, they had graduated from elementary school or higher levels of schooling and had the ability to read and write.

The ethical review committee of Kashan University of Medical Sciences approved the study. The participants provided written informed consent and were informed of their right to withdraw from the study at any time.

2.3. Statistical analysis

We used the Kolmogorove-Smirnov, Mann-Whitney U, and Wilcoxon tests to evaluate the data and variables and assess whether they met the assumptions for parametric tests [39]. Continuous demographic variables were reported with mean and standard deviation, and categorical demographic variables were reported with frequencies and percentages. At the beginning of the study, the experimental and control groups were compared in terms of their socio-demographic characteristics using the Chi-square and independent samples *t*-test. The paired sample *t*-test was used to compare the QOL of each group at the beginning and at the end of the study [39]. The data was analyzed using SPSS software version 19, and the level of significance was set at 0.05.

3. Results

There was no attrition in the two groups' participants. The mean age of experimental and control groups was 49.12 ± 10.3 and 52.11 ± 11.4, respectively. Eighty-four percent of the experimental group and eighty percent of the control group were male. Ninety-six percent of the participants in the experimental group and 88% in the control group were married. Glomerular Filtration Rate (GFR) (mL/min/1.73 m^2) in the experimental group was 45.3 ± 2.3 and in the control group was 41.5 ± 3.1. There was no significant difference between the two groups in terms of their demographic characteristics ($p > 0.05$) (Table 1).

The mean scores of the QOL dimensions before and after intervention are presented in Table 2. In the experimental group, the total scores of the QOL and the domains after the intervention were greater than at the beginning of the study ($p \le 0.05$) (Table 2). In the control group, however, these differences were not significant.

Comparison of the mean differences of the QOL domains at the beginning and then two months after the study of both groups showed that there were significant differences between the mean difference scores of the QOL domains of the two groups ($p \le 0.05$). The scores of the experimental group were significantly greater than the scores of the control group (Table 3).

4. Discussion

In this study, we investigated the effects of pilates exercises on CKD patients' QOL and QOL domains. The experimental group's QOL was improved after a period of pilates exercises. However, in the control group, no significant difference in the participants' QOL at the beginning and end of the study was observed. Previous studies regarding the effects of the pilates exercises on QOL were conducted in other

Table 1
Demographic characteristics of the groups.

Variable		Groups		p value
		Experimental (*N* = 25)	Control (*N* = 25)	
Age (year)[a]		49.12 ± 10.3	52.11 ± 11.4	t = 3.21 P = 0.62
Number of children[a]		4.2 ± 2.1	5.6 ± 2.3	t = 2.49 P = 0.08
GFR (mL/min/1.73 m^2)[a]		45.3 ± 2.3	41.5 ± 3.1	t = 3.01 P = 0.31
Sex[b]	Female	4 (16)	5 (20)	χ^2 = 4.21
	Male	21 (84)	20 (80)	P = 0.71
Education[b]	Elementary	20 (80)	19 (76)	χ^2 = 3.11
	Higher than elementary	5 (20)	6 (24)	P = 0.25
Marital status[b]	Single	24 (96)	22 (88)	χ^2 = 3.33
	Married	1 (4)	3 (12)	P = 0.34
Occupational status[b]	Office worker	2 (8)	2 (8)	χ^2 = 4.65
	Employed	4 (16)	2 (8)	P = 0.89
	Retired	7 (28)	9 (36)	
	Housewife	3 (12)	5 (20)	
	Unemployed	4 (16)	3 (12)	
	Self-employed	5 (20)	4 (16)	

Note.
[a] Continuous data are presented using mean ± standard deviation (SD).
[b] Categorical data are presented using number (percent).

populations using different designs [19–27,40–45]. These studies indicated contradictory results in terms of the effects of pilates on QOL.

Several research teams studied QOL and the general health of different populations while using pilates interventions and found significant improvements in QOL dimensions [10,19–22,46]. However, inconsistencies exist in their intervention duration and designs; therefore, professionals may fail to introduce a standard protocol for evidence-based practice. In some studies, the exercise durations were 12 weeks [47], six months [27,48], and 12 months [49], which were longer than our intervention duration. In other studies, the total intervention durations were shorter than our study and were four weeks [50], five weeks [51], six weeks [52], and eight weeks [53]. In this regard, de Souza and Vieira [54] emphasized that there are no established protocols on pilates exercises that are commonly used. It is valuable to address effective protocols in order to introduce established protocols in future studies.

Cruz-Ferreira et al. [48] reported a significant improvement in QOL for adult women after a six-month pilates intervention; however, their result was not significant after three months. In contrast, the results of the current study were consistent with the studies that showed effectiveness of three-month pilates interventions [18,47,51]. Rodrigues et al. [30] indicated that the pilates exercises, two times per week for eight weeks, improved QOL of older women. Eyigor et al. reported that combined home exercise and supervised pilates activities, three times a week for eight weeks, improved QOL of female breast cancer patients [55]. However, with a similar intervention over 12 weeks, patients with ankylosing spondylitis did not show significant improvements in their QOL [56].

By having their patients use pilates exercises three times a week for eight weeks, Kucuk et al. showed significant improvements in physical health and mental health dimensions of QOL in patients with multiple sclerosis [31]; however, the total QOL was not significantly improved in their study. Similar results were reported in patients with chronic unspecific lower back pain [57] and cancer [54]. Borges et al. [58] indicated that after pilates exercises, QOL dimensions, except for physical functioning, had significant improvements in patients with lower back pain. Angin et al. [59] showed that physical functioning and general health dimensions along with the total QOL of patients with multiple sclerosis significantly improved with the exercises. The differences among the studies' results may be due to methodological limitations or differences among exercise designs, including the number of exercise sessions, durations, the intervals between sessions, and execution of movements. In general, evidence supports the use of pilates exercises in patients with chronic illnesses and shows that pilates exercises can lead to improvement of abdominal strength, endurance, trunk flexibility, dynamic balance of the body, and QOL of patients [60].

There is a shortage of studies focusing on CKD patients and pilates interventions. To confirm the findings, further clinical trials on CKD patients are necessary. Additionally, clinical trials fail to provide an explanation for the inconsistent findings among relevant studies. Therefore, systematic reviews and meta-analyses are required to establish a therapeutic protocol for patients and evidence-based practices. The small sample sizes of the current and relevant studies may account

Table 3
Comparison of the mean differences of quality of life dimensions at the beginning and two months after the study in the two groups.

QOL domain	Experimental group (Mean ± SD)	Control group (Mean ± SD)	P value
(PCS)	31.7 ± 0.9	1.6 ± 1.3	t = 2.87 P = 0.002
(MCS)	36.2 ± 1.4	0.5 ± 1.6	t = 2.76 P = 0.001
(KDCS)	22.1 ± 1.3	3 ± 1.3	U = 1.32 P = 0.001
KDQoL-SF36(Total QoL)	30.1 ± 0.67	0.3 ± 7.4	U = 1.31 P = 0.001

Note. a. the mean difference is defined as the mean scores at the end minus the mean scores at the beginning of the study, PCS: Physical Health Components Summary, MCS: Mental Health Components Summary, KDCS: Kidney Disease Components Summary, t = Independent samples *t*-test, U = Mann-Whitney test.

Table 2
Comparing mean scores of quality of life dimensions before and two months after the study in the two groups.

QOL domains	Experimental group			Control group		
	Before (Mean ± SD)	After (Mean ± SD)	*p* Value	Before (Mean ± SD)	After (Mean ± SD)	p value
(PCS)	22.1 ± 12.1	53.8 ± 11.2	t = 2.67 p = 0.001	22.3 ± 13.3	23.9 ± 12	t = 4.11 p = 0.17
(MCS)	15.3 ± 13.2	51.5 ± 14.6	t = 1.98 p = 0.001	16.9 ± 13.3	17.4 ± 11.7	t = 3.45 p = 0.79
(KDCS)	28.5 ± 12.0	50.6 ± 13.3	W = 3.09 p = 0.001	24.5 ± 12.9	21.5 ± 11.6	W = 1.23 p = 0.17
KDQoL-SF36 (Total QoL)	21.9 ± 12.4	52 ± 13.07	t = 1.67 p = 0.001	21.2 ± 4.4	20.9 ± 11.8	t = 3.43 p = 0.25

Note. PCS: Physical Health Components Summary, MCS: Mental Health Components Summary, KDCS: Kidney Disease Components Summary, t: Paired sample *t*-test, W = Wilcoxontest.

for the inconsistencies in the findings.

The generalizability of the findings is limited due to a small sample size. Studies with larger sample sizes would be valuable to help generalize the findings to a larger population. In the experimental group, presence of the research group member (the first author) for training could be a confounding variable. The group nature of the exercise intervention and the presence of the researcher might interfere with the results related to the improvement of QOL. Marinda et al. have asserted that group activities can help improve individuals' socialization and confidence through which patients' symptoms, such as stress and anxiety, may be reduced [37].

Taking these arguments and the contradictory results of pilates into account, safe designs of exercises are essential for chronically ill patients, including those with CKD. In this study, no injuries occurred during the intervention.

5. Conclusion

Our findings indicated that pilates exercises were effective for improving the participants' QOL and its dimensions. Due to the cost-effectiveness and safety of this intervention, we propose the inclusion of this exercise in CKD patients' treatment protocols. However, further studies are recommended for confirming the findings in CKD patients and the establishment of a standard protocol.

There is a need for further investigation and verification of new and safe therapeutic interventions to provide effective care for chronic patients. Moreover, studies to compare the effects of the pilates exercises and another group intervention would help to ensure the accuracy of the interpretation of findings.

Funding

Funding for this study was provided by the Kashan University of Medical Sciences, Iran.

Conflicts of interest

The authors declare no conflict of interest in this study.

Authorship

All authors made signficant contributions to the study design, acquisition of data, drafting of the manuscript, and final approval of the manuscript.

Acknowledgements

We are grateful to our participants.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ctcp.2018.10.017.

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