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EXERCISE PHYSIOLOGY STUDY

# Effects of Pilates exercise on general health of hemodialysis patients

Zahra Rahimimoghadam, MSc [a], Zahra Rahemi, MSN, PhD [b,c], Neda Mirbagher Ajorpaz, PhD [d,*], Zohre Sadat, PhD [c]

[a] *Kashan University of Medical Sciences, Kashan, Iran*
[b] *Florida Atlantic University, FL, USA*
[c] *Department of Nursing and Midwifery, Kashan University of Medical Sciences, Kashan, Iran*
[d] *Autoimmune Diseases Research Center, Department of Nursing and Midwifery, Kashan University of Medical Sciences, Kashan, Iran*

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**Summary** Pilates is a type of exercise which has recently drawn exercise and health experts' attention. They have noticed that it can improve hemodialysis patients' general health. A clinical trial study was performed. Fifty hemodialysis patients were randomly assigned to intervention and control groups. A demographic information questionnaire and a general health questionnaire (GHQ-28) were completed by the two groups at the beginning of the study. Then, modified Pilates exercises were carried out in the intervention group three times a week over a period of eight weeks. At the end of the study, the GHQ-28 questionnaire was completed by the two groups. In the intervention group, the difference between the mean scores of general health before ($45.24 \pm 9.9$) and after ($31.2 \pm 6.9$) the intervention was significant ($p \leq 0.002$). After the intervention, the difference between the mean scores of the control ($1.6 \pm 1.3$) and intervention ($14 \pm 0.78$) groups was also significant ($p \leq 0.001$).
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## Introduction

Chronic renal failure (CRF) is a major international health problem (Williams and Manias, 2008). Patients undergo health challenges that lead them to change their daily lifestyles including adjusting their diets, using medications, and experiencing frequent hemodialysis (Abraham et al., 2012). Although hemodialysis is the most common treatment for these patients, it results in several adverse

* Corresponding author. Tel.: +98 55540021.
*E-mail addresses:* zrahimimoghadam@yahoo.com (Z. Rahimimoghadam), zrahemi2013@fau.edu (Z. Rahemi), mirbagher_n@kaums.ac.ir (N. Mirbagher Ajorpaz), sadat@kaums.ac.ir (Z. Sadat).

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complications, such as food and fluid restrictions, pain in fistula, multiple hospitalizations, and financial burdens (Akin et al., 2014). Multiple complications, such as sleep disturbance, depression, anxiety, and social isolation contribute to patients' reduced physical functioning, decreased quality of life, and poor general health (Aucella et al., 2015; Cohen et al., 2007; Gerogianni and Babatsikou, 2013; Hmwe et al., 2015; Parvan et al., 2013; Wang et al., 2012). Therefore, nursing and therapeutic interventions are required to deal with patients' mental and physical complications and disabilities (Johnson and Dwyer, 2008).

The World Health Organization (WHO) defined general health as an individual's physical, mental, social, and moral well-being (WHO, 2008). Maintenance of regular activities or improvement of physical exercise can enhance the general health of hemodialysis patients (Rhee and Kalantar-Zadeh, 2014). Besides medical interventions, complementary and alternative medicine suggests new therapeutic options with the goal of improving general health, reducing symptoms, and decreasing negative consequences and costs of conventional treatments (Birdee et al., 2013). Complementary and alternative medicine is a set of unconventional medical and healthcare interventions. These interventions include the use of biologically-based products such as dietary supplements, and mind-body exercises like yoga, deep breathing, and meditation (Duncan et al., 2007; Nowack et al., 2009).

Regular exercise improves mental function, reduces anxiety and depression, and improves temperament and happiness partly due to an increase in growth, cortisol, and serotonin hormones released in the body (Eyigor et al., 2010; Krogh et al., 2010). Cupist et al. (2011) reported that regular physical exercise plays a pivotal role in patients' rehabilitation and the improvement of aspects of their physical health, such as cardiovascular, metabolic, and nutritional conditions (Cupisti et al., 2011). Maniam et al. (2014) revealed that physical exercise helps hemodialysis patients to improve their physical and mental conditions. Although exercise is widely recommended for hemodialysis patients, the physical demands of exercise, along with multiple complications of the disease and treatments, hinder patients to incorporate exercise programs into their conventional treatments (Jung and Park, 2011). Therefore, sports and rehabilitation experts have frequently suggested Pilates exercises to overcome patients' problems related to exercise programs (Caldwell et al., 2009; Dunleavy, 2010; Rodrigues et al., 2010).

Pilates exercises, introduced by Joseph Pilates, are sets of activities that positively affect strength, posture, and flexibility of the body. Mostly exercises have effects on the physical aspects of patients' health (Neumark-Sztainer et al., 2011; Guimarães et al., 2012; Mallin and Murphy, 2013). However, Pilates exercises are combinations of physical and mental training through which individuals can balance their mind-body interactions and ultimately enhance their general health status (Guimarães et al., 2012). Pilates exercises are based on six principles including centering, concentration, precision, control, flow, and breath (Caldwell et al., 2009), and combinations of different static postures including supine, sitting, and quadruped, without movements such as jumping and leaping. Therefore, a modified Pilates exercise can be a choice for chronically ill patients because it minimizes the inherent risks of muscular and joint injuries that movements in other exercises can pose (Emery et al., 2010; Boguszewski et al., 2012; Tunar et al., 2012; Wells et al., 2013). The main goal in Pilates exercises is strength and flexibility improvement. In other words, using a mind-body exercise approach and focusing on muscle control, posture, and breathing can improve an individual's core stability, strength, and flexibility (Patti et al., 2016).

## Literature review

Different studies showed positive effects of Pilates exercises on dimensions of general health and quality of life using different designs of exercise and populations. They included Pilates exercises 3 sessions per week during eight weeks in older men (Pourvaghar et al., 2014), two times a week over a three-week period in older and adult women (Cruz-Ferreira et al., 2011; Rodrigues et al., 2010), two times a week for three months among middle aged men and women (Garcia-Soidan et al., 2014), three times a week over an eight-week period in women with breast cancer (Eyigor et al., 2010), 3 sessions per week over eight weeks among women with type 2 diabetes mellitus (Torabian et al., 2013), and 2 times a week for six months in patients with idiopathic arthritis (Mendonca et al., 2013). Furthermore, Jang and Kim (2009) and Liu and colleagues (2015) found that aerobic exercises improved the general health and reduced depression in hemodialysis patients.

On the contrary, Segal et al. (2004) found that Pilates exercise an hour a week over six months had no effect on the physical and general health of healthy adult participants (Segal et al., 2004). Likewise, Kuo et al. (2009) showed that two 20-minute Pilates sessions per week for 10 weeks had no effect on older adults' physical health (Kuo et al., 2009). Parsons et al. (2006) and Jung and Park (2011) conducted clinical trials using aerobic and resistance exercises in hemodialysis patients. They found that 30-minute intradialytic trainings three times a week over 8-weeks (Parsons et al., 2006) and 10 time for 2 weeks (Pinto et al., 2015) had no effect on the respiratory muscle strength of chronic renal patients.

The high prevalence of CRF and growing population of hemodialysis patients with multiple complications urge nurses to provide innovative strategies including mind-body interventions for patients (Gerogianni and Babatsikou, 2013). Evidence demonstrated the effects of Pilates exercise in several populations (Eyigor et al., 2010; Garcia-Soidan et al., 2014; Cruz-Ferreira et al., 2011). However, to the authors' knowledge, this is the first study that explored the effects of a modified Pilates exercise on hemodialysis patients. There is a gap in knowledge about complementary and alternative treatments, particularly among patients with renal diseases (Duncan et al., 2007; Nowack et al., 2009).

Due to the contradictory results of previous studies with different designs, further research is required to first, verify the effectiveness of Pilates exercise and second, introduce an effective design of this exercise for hemodialysis patients. Eyigor et al. (2010) emphasized that ongoing research is required to verify the effectiveness of

this intervention in different and growing populations of patients with chronic diseases. The purpose of this study was to evaluate the effects of Pilates exercise on the general health status of the hemodialysis patients.

## Methods

### Ethics statement

The study was approved by The Research Deputy and The Research Ethics Committee of The Kashan University of Medical Sciences, Iran. All participants completed consent forms and were willing to participate in the study.

### Design and data collection

This clinical trial included 50 hemodialysis patients with CRF admitted to Akhavan Hospital, Kashan, Iran. Inclusion criteria consisted of an age of 18–65 years, a history of hemodialysis treatment 2–3 times per week for at least 6 months, the physical ability to perform basic daily activities, and a nephrologist's permission to practice the exercise. Exclusion criteria included three or more sessions of absence in exercises; being a habitual Pilates practitioner; detection of reduced exercise tolerance, including tachycardia, shortness of breath, and feeling too tired or weak; peritoneal dialysis during the study; and other concurrent clinical conditions, such as cardio-respiratory problems reported by physician and/or patients.

The sample size in each group was calculated based on the following assumptions: power = 0.80, $\alpha = 0.05$, the minimum expected difference in standard deviations = 2.9, and the minimum expected difference in means = 2.18 (Eyigor et al., 2010). Using the Pocock's sample size formula (Pocock, 1983), the optimal sample size of each group was estimated to be 25 participants.

Using the randomized block design, participants were assigned to either an intervention or control group. At the beginning of the study, all the participants completed a socio-demographic questionnaire, including questions about gender, age, marital status, job, level of education, and dialysis duration, as well as the general health questionnaire-28 (GHQ-28). All the participants had the ability to complete the questionnaires.

The GHQ-28 was created by Goldberg and Hillier in 1979 (Goldberg and Hillier, 1979) and there are several versions of the instrument including different numbers of items ranging from 12 to 60. The GHQ-28 includes four subscales including physical symptoms, anxiety, social function, and depression. The sample questions from these subscales include: "Have you recently been getting any pains in your head?", "Have you recently felt constantly under strain?", "Have you recently been taking longer over the things you do?", and "Have you recently found yourself wishing you were dead and away from it all?" Each subscale consists of seven Likert-type questions ranging from 0 (never) to 3 (always). The total score of the instrument ranges from 0 to 84. The overall score of the scale indicates the individual's level of general health. Higher scores indicate lower level of general health (Bashiri et al., in press). Psychometric properties of the scale were confirmed in 15 culturally and linguistically different populations, worldwide (Werneke et al., 2000). In Iran, the instrument was translated to Persian, and face validity, content validity, and internal consistency of the Persian version of the instrument and the subscales were verified (Javanmard and Mamaghani, 2013).

### Intervention method

A clinical trial study was performed with 50 hemodialysis patients in Akhavan Hospital, Iran, from July 2015 to October 2015. Prior to the intervention, a specialist in nephrology and hemodialysis assessed the participants in the intervention group in terms of their ability to exercise. The intervention and control groups received routine care for hemodialysis patients. In addition to the routine care, modified Pilates exercise, three 45-minute sessions a week for 8 weeks, was assigned to the intervention group.

In this study, a modified Pilates exercise protocol for chronically ill patients suggested by Ashrafinia et al. (2014) was used. The sessions were administered by a qualified professional in Pilates exercises in the hospital's gym. During each session, the professional coached a group of 3–5 participants to ensure an adequate execution of movements. The exercise included 13 movements: Bridging, Hundred, Roll Up, One Leg Circle (both ways), Rocker with close 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. Before and after exercise, warming up and cooling down movements were performed. In this protocol, flexion-extension movements with a focus on deep breathing and whole body stretches were performed.

The risk of the exercise for the participants was assessed by an expert in sport physiology and noted to be a minor risk. According to the nephrologist and exercise professional, the exercise was carried out during the days in which hemodialysis was not administered. According to the Iranian Association of Renal Patients, the exercises were carried out in the mornings. During the course of the program, the repetition and intensity of exercises were gradually increased. In the first week, all 13 movements were repeated 4 times per session. Then in each week, two more repetitions of all movements were added. Therefore, in week 4, all the movements were performed 10 times and continued until the end of the program. After the completion of the study, the participants in the intervention group were provided additional information about the benefits and costs of the Pilates exercise by the sport professional using educational videos, CDs, and pamphlets. Furthermore, for the control group, an educational session on hemodialysis cares was provided. The participants in the control group were asked about physical activities beyond their routine daily activities for the purpose of exclusion. The participants in the two groups were followed up by weekly phone calls for further consultations.

Using a demographic questionnaire, demographic characteristics of the participants, including age, gender, education, occupation, and duration of hemodialysis, were assessed at the beginning of the study. The GHQ-28 was completed by all participants, at the beginning and one

week after completion of the intervention. The investigator (first author) read the questions for the participants who were illiterate.

### Statistical analysis

Using the Kolmogorov–Smirnov and Whitney-U tests, all data and variables were evaluated to assess whether they met the assumptions for parametric tests (Munro, 2004). Continuous demographic variables were reported with mean and standard deviation, and categorical demographic variables were reported with frequencies and percentages. The chi-square and independent t-tests were used to compare the two groups. The paired t-test was also used to compare the mean scores of each group at the beginning and at the end of the program (Munro, 2004). The level of significance was set at 0.05. The data were analyzed using SPSS software version 16.

## Results

There was no attrition in the intervention and control groups' participants. The mean age for the intervention group ($n = 25$) was 39.1 $\pm$ 2.2and for the control group ($n = 25$) was 38.4 $\pm$ 1.8. In total, 84% ($n = 21$) of the intervention group and 80% ($n = 20$) of the control group were male. No significant differences were observed between the two groups in terms of the demographic characteristics ($p > 0.05$) (Table 1).

There was no significant difference between the mean scores of the general health of the two groups at the beginning of the study ($p \geq 0.05$). No significant difference was observed between the mean scores of the general health before and after the study in the control group ($p \geq 0.21$). In the intervention group, the difference between the mean scores of the general health before (45.24 $\pm$ 9.9) and after (31.2 $\pm$ 6.9) intervention was significant ($p = 0.002$). In this group, a significant difference was found between all subscales' scores before and after intervention (Table 2). Comparing the control and intervention groups after the intervention, the mean score of the general health in the intervention group (14 $\pm$ 0.87) was higher than the control group (1.6 $\pm$ 1.3) ($p = 0.001$). In this comparison, the differences between the scores of all dimensions of the general health were significant ($p \leq 0.05$) (Table 3).

**Table 1** Demographic characteristics of the groups.

| Variable | | Intervention group N (%) | Control group N (%) | P value |
|---|---|---|---|---|
| Gender | Female | 4 (16%) | 5 (20%) | P = 0.36* |
| | Male | 21 (84%) | 20 (80%) | |
| Marital status | Married | 24 (96%) | 22 (88%) | P = 0.3* |
| | Single | 1 (4%) | 3 (12%) | |
| Occupation | Office Worker | 2 (8%) | 2 (8%) | P = 0.89* |
| | Worker | 4 (16%) | 2 (8%) | |
| | Retired | 7 (28%) | 9 (36%) | |
| | Housekeeper | 3 (12%) | 5 (20%) | |
| | Unemployed | 4 (16%) | 3 (12%) | |
| | Self-employed | 5 (20%) | 4 (16%) | |
| Education | Uneducated | 3 (12%) | 5 (20%) | P = 0.12* |
| | Less than high-school | 9 (36%) | 11 (44%) | |
| | High-school graduate | 8 (32%) | 5 (20%) | |
| | University | 5 (20%) | 4 (16%) | |
| Age (year) | | 39.1 $\pm$ 2.2 | 38.4 $\pm$ 1.8 | P = 0.74 |
| Duration of Hemodialysis (month) | | 32.2 $\pm$ 28.2 | 45.5 $\pm$ 49.5 | P = 0.76** |

Note. * = Based on a Chi–Square test, ** = Based on a Mann–Whitney U test.

**Table 2** Comparing mean scores of general health dimensions before and after the study in the two groups.

| General health dimensions | Intervention group | | | Control group | | |
|---|---|---|---|---|---|---|
| | Before mean (SD) | After mean (SD) | p-value* | Before mean (SD) | After mean (SD) | p-value* |
| Physical Symptoms | 10.8 (4.07) | 7.5 (2.95) | 0.00 | 11.4 (3.5) | 11.36 (3.7) | 0.8 |
| Anxiety | 11.92 (4.13) | 8.4 (2.9) | 0.001 | 12.3 (3.7) | 12 (3.8) | 0.1 |
| Social Dysfunction | 10.68 (2.09) | 6.72 (2.15) | 0.001 | 10.6 (3.51) | 10.6 (3.67) | 1 |
| Depression | 11.7 (3.5) | 8.6 (3.06) | 0.002 | 11.7 (6.6) | 10.4 (2.4) | 0.2 |
| Total Score of General Health | 45.24 (9.9) | 31.2 (6.9) | 0.002 | 46 (8.6) | 44.4 (7.37) | 0.21 |

Note. * = Based on a Paired t-test.

**Table 3** Comparing the mean differences* of general health dimensions at the beginning and the end of the study in the two groups.

| General health dimensions | Intervention group | Control group | p value** |
|---|---|---|---|
| | Mean (SD) | Mean (SD) | |
| Physical Symptoms | 4.04 (4.33) | 0.04 (0.78) | 0.001 |
| Anxiety | 3.5 (0.34) | 0.32 (0.18) | 0.001 |
| Social Dysfunction | 3.9 (0.27) | 0 (0.2) | 0.002 |
| Depression | 3.2 (0.35) | 1.32 (1.2) | 0.003 |
| Total Score of General Health | 14 (0.87) | 1.6 (1.3) | 0.001 |

Note. * = The mean differences are defined by the mean scores of general health dimensions at the end of the study minus the mean scores of general health dimensions at the beginning of study, ** = Based on a Mann–Whitney U test.

## Discussion

Our findings confirmed the results of other studies regarding the positive effects of Pilates exercise on the dimensions of the general health status including physical symptoms, anxiety, social function, and depression. At the end of the study, differences between the scores of the control and intervention groups were significant. These differences in the intervention group, before and after the exercise, were also significant. However, in the control group no difference was observed between the scores of the general health at beginning and the end of the study.

Several studies were in agreement with the findings in terms of the significance of Pilates exercises in improving the health status of different populations (Cruz-Ferreira et al., 2011; Eyigor et al., 2010; Garcia-Soidan et al., 2014; Mendonca et al., 2013; Pourvaghar et al., 2014; Rodrigues et al., 2010; Torabian et al., 2013). Furthermore, there are evidence regarding positive effects of aerobic exercises on hemodialysis patients (Jang and Kim, 2009; Liu and colleagues 2015).

However, several other studies indicated no significant effects of Pilates and other exercises on different populations including hemodialysis patients (Kuo et al., 2009; Parsons et al., 2006; Segal et al., 2004). The contradictory results among the studies may be due to methodological limitations of the studies or differences among their exercise designs. The differences among exercise designs may include the number of exercise sessions, training duration, intervals between sessions, and execution of movements.

There are also arguments about real predicators of positive results in exercise interventions. One of the predicators that may interfere in results of exercise clinical trials is the group nature of activities. Marinda et al. (2013) designed an individual Pilates exercise and showed the positive effects of the exercise on reducing stress and anxiety in older women. They argued that the group nature of some designs for exercise can be the significant predictor of positive outcomes in clinical trials. Marinda et al. (2013) explained that since group exercises can help to advance socialization and confidence in individuals, they subsequently can reduce symptoms such as stress and anxiety (Marinda et al., 2013).

Taking this argument and the contradictory results of Pilates into account, this study was conducted to investigate the effects of this exercise in hemodialysis patients. To improve mind-body care and general health for patients surviving from CRF, safe designs of interventions are essential. There is a need for nurses to further investigate and verify new therapeutic methods to provide effective care for patients.

### Limitations and recommendations

Generalizability of our findings is limited to a small sample size. Furthermore, the lack of a group intervention in the control group may contribute to a poor interpretation of the results regarding the effectiveness of the exercise as the single predictor of the outcomes. A small number of studies have been conducted on the effects of Pilates exercises in the hemodialysis patients, and these studies have resulted in contradictory findings. Therefore, further research with larger sample size in these patients is recommended. Conducting a study to compare the effects of the Pilates exercise and another group intervention can help ensure the accuracy of the interpretation of findings regarding the effectiveness of exercise.

## Conclusion

According to the findings, the Pilates exercise can be considered as an effective alternative for improving hemodialysis patients' general health, physical and mental status, and social function. Due to the cost-effectiveness and safety of this method, we propose the inclusion of this program in the treatment protocol for hemodialysis patients.

## Conflict of interest

The authors declare no conflict of interest in this study.

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## References


Abraham, S., Venu, A., Ramachandran, A., Chandran, P.M., Raman, S., 2012. Assessment of quality of life in patients on hemodialysis and the impact of counseling. Saudi J. Kidney Dis. Transpl. 23, 953—957.

Akin, S., Mendi, B., Ozturk, B., Cinper, C., Durna, Z., 2014. Assessment of relationship between self-care and fatigue and loneliness in haemodialysis patients. J. Clin. Nurs. 23, 856—864.

Ashrafinia, F., Mirmohammadali, M., Rajabi, H., Kazemnejad, A., Sadeghniiathaghighi, K., Amelvalizadeh, M., Chen, H., 2014. The effects of Pilates exercise on sleep quality in postpartum women. J. Bodyw. Mov. Ther. 18, 190—199.

Aucella, F., Battaglia, Y., Bellizzi, V., Bolignano, D., Capitanini, A., Cupisti, A., 2015. Physical exercise programs in CKD: lights, shades and perspectives. J. Nephrol. 28, 143—150.

Bashiri, Z., Aghajani, M., Masoudi Alavi, N., 2016. Effects of psychoeducation on mental health in patients with coronary heart disease. Iran. Red. Crescent Med. J. (in press).

Birdee, G.S., Phillips, R.S., Brown, R.S., 2013. Use of complementary and alternative medicine among patients with end-stage renal disease. Evid. Based Complement. Altern. Med. 2013, 654109.

Boguszewski, D., Adamczyk, J., Ochal, A., 2012. The role of Pilates and aquafitness exercises in sustaining the health and fitness of elderly women. J. Sport Sci. 21, 127—138.

Caldwell, K., Harrison, M., Adams, M., Triplett, N.T., 2009. Effect of Pilates and taiji quan training on self-efficacy, sleep quality, mood, and physical performance of college students. J. Bodyw. Mov. Ther. 13, 155—163.

Cohen, S.D., Patel, S.S., Khetpal, P., Peterson, R.A., Kimmel, P.L., 2007. Pain, sleep disturbance, and quality of life in patients with chronic kidney disease. Clin. J. Am. Soc. Nephrol. 2, 919—925.

Cruz-Ferreira, A., Fernandes, J., Gomes, D., Bernardo, L.M., Kirkcaldy, B.D., Barbosa, T.M., Silva, A., 2011. Effects of Pilates-based exercise on life satisfaction, physical self-concept and health status in adult women. Women Health 51, 240—255.

Cupisti, A., Capitanini, A., Betti, G., D'Alessandro, C., Barsotti, G., 2011. Assessment of habitual physical activity and energy expenditure in dialysis patients and relationships to nutritional parameters. Clin. Nephrol. 75, 218—225.

Duncan, H.J., Pittman, S., Govil, A., Sorn, L., Bissler, G., Schultz, T., Faith, J., Kant, S., Roy Chaudhury, P., 2007. Alternative medicine use in dialysis patients: potential for good and bad. Nephron Clin. Pract. 105, 108—113.

Dunleavy, K., 2010. Pilates fitness continuum: post-rehabilitation and prevention Pilates fitness programs. Rehab. Manag. 23, 10—12.

Emery, K., De Serres, S.J., McMillan, A., Côté, J.N., 2010. The effects of a Pilates training program on arm-trunk posture and movement. Clin. Biomech. 25, 124—130.

Eyigor, S., Karapolat, H., Yesil, H., Uslu, R., Durmaz, B., 2010. Effects of Pilates exercises on functional capacity, flexibility, fatigue, depression and quality of life in female breast cancer patients: a randomized controlled study. Eur. J. Phys. Rehabil. Med. 46, 481—487.

Garcia-Soidan, J.L., Giraldez, V.A., Cachon Zagalaz, J., Lara-Sanchez, A.J., 2014. Does Pilates exercise increase physical activity, quality of life, latency, and sleep quantity in middle-aged people? Percept. Mot. Ski. 119, 838—850.

Gerogianni, G.K., Babatsikou, F.P., 2013. Identification of stress in chronic haemodialysis. Health Sci. 7, 169—176.

Goldberg, D.P., Hillier, V.F., 1979. A scaled version of the General Health Questionnaire. Psychol. Med. 9, 139—145.

Guimarães, G.V., Carvalho, V.O., Bocchi, E.A., Avila, V.M., 2012. Pilates in heart failure patients: a randomized controlled pilot trial. Cardiovasc Ther. 30, 351—356.

Hmwe, N.T., Subramanian, P., Tan, L.P., Chong, W.K., 2015. The effects of acupressure on depression, anxiety and stress in patients with hemodialysis: a randomized controlled trial. Int. J. Nurs. Stud. 52, 509—518.

Jang, E.J., Kim, H.S., 2009. Effects of exercise intervention on physical fitness and health-related quality of life in hemodialysis patients. J. Korean Acad. Nurs. 39, 584—593.

Javanmard, G.H., Mamaghani, J., 2013. Standardization of GHQ-28 Inventory on the students of Azerbaijan Province of Iran. Procedia Social Behav. Sci. 84, 47—52.

Johnson, S., Dwyer, A., 2008. Patient perceived barriers to treatment of depression and anxiety in hemodialysis patients. Clin. Nephrol. 69, 201—216.

Jung, T.D., Park, S.H., 2011. Intradialytic exercise programs for hemodialysis patients. Chonnam. Med. J. 47, 61—65.

Krogh, J., Nordentoft, M., Mohammad-Nezhad, M., Westrin, A., 2010. Growth hormone, prolactin and cortisol response to exercise in patients with depression. J. Affect Disord. 125, 189—197.

Kuo, Y.L., Tully, E.A., Galea, M.P., 2009. Sagittal spinal posture after Pilates-based exercise in healthy older adults. Spine 34, 1046—1051.

Liu, Y.M., Chung, Y.C., Chang, J.S., Yeh, M.L., 2015. Effects of aerobic exercise during hemodialysis on physical functional performance and depression. Biol. Res. Nurs. 17, 214—221.

Mallin, G., Murphy, S., 2013. The effectiveness of a 6-week Pilates programme on outcome measures in a population of chronic neck pain patients: a pilot study. J. Bodyw. Mov. Ther. 17, 376—384.

Maniam, R., Subramanian, P., Singh, S.K., Lim, S.K., Chinna, K., Rosli, R., 2014. Preliminary study of an exercise programme for reducing fatigue and improving sleep among long-term haemodialysis patients. Singap. Med. J. 55, 476—482.

Marinda, F., Magda, G., Ina, S., Brandon, S., Abel, T., Ter Goon, D., 2013. Effects of a mat Pilates program on cardiometabolic parameters in elderly women. Pak J. Med. Sci. 29, 500—504.

Mendonca, T.M., Terreri, M.T., Silva, C.H., Neto, M.B., Pinto, R.M., Natour, J., Len, C.A., 2013. Effects of Pilates exercises on health-related quality of life in individuals with juvenile idiopathic arthritis. Arch. Phys. Med. Rehabil. 94, 2093—2102.

Munro, B.H., 2004. Statistical Methods for Health Care Research, fifth ed. Lippincott Williams & Wilkins, Philadelphia, PA.

Neumark-Sztainer, D., Eisenberg, M.E., Wall, M., Loth, K.A., 2011. Yoga and Pilates: associations with body image and disordered-eating behaviors in a population-based sample of young adults. Int. J. Eat. Disord. 44, 276—280.

Nowack, R., Ballé, C., Birnkammer, F., Koch, W., Sessler, R., Birck, R., 2009. Complementary and alternative medications consumed by renal patients in southern Germany. J. Ren. Nutr. 19, 211—219.

Parsons, T.L., Toffelmire, E.B., King-VanVlack, C.E., 2006. Exercise training during hemodialysis improves dialysis efficacy and physical performance. Arch. Phys. Med. Rehabil. 87, 680—687.

Parvan, K., Lakdizaji, S., Roshangar, F., Mostofi, M., 2013. Quality of sleep and its relationship to quality of life in hemodialysis patients. J. Caring Sci. 2, 295—304.

Patti, A., Bianco, A., Paoli, A., Messina, G., Montalto, M.A., Bellafiore, M., Battaglia, G., Iovane, A., Palma, A., 2016. Pain perception and stabilometric parameters in people with chronic low back pain after a Pilates exercise program: a randomized controlled trial. Med. Baltim. 95, 2414.

Pinto, J.S., Sarmento, L.A., Pereira da Silva, A.P., Cabral, C.M., Chiavegato, L.D., 2015. Effectiveness of conventional physical therapy and Pilates' method in functionality, respiratory muscle strength and ability to exercise in hospitalized chronic renal patients: a study protocol of a randomized controlled trial. J. Bodyw. Mov. Ther. 19, 604—615.

Pocock, S.J., 1983. Clinical Trials: a Practical Approach. John Wiley & Sons, Chichester.

Pourvaghar, M.J., Bahram, Sharif MR., Sayyah, M., 2014. Effects of eight weeks of Pilates exercise on general health condition of aged male adults. Int. J. Sport Stud. 4, 895—900.

Rhee, C.M., Kalantar-Zadeh, K., 2014. Resistance exercise: an effective strategy to reverse muscle wasting in hemodialysis patients? J. Cachexia, Sarcopenia Muscle 5, 177—180.

Rodrigues, B.G., Ali Cader, S., Bento Torres, N.V., Oliveira, E.M., Martin Dantas, E.H., 2010. Pilates method in personal autonomy, static balance and quality of life of elderly females. J. Bodyw. Mov. Ther. 14, 195—202.

Segal, N.A., Hein, J., Basford, J.R., 2004. The effects of Pilates training on flexibility and body composition: an observational study. Arch. Phys. Med. Rehabil. 85, 1977—1981.

Torabian, M., Taghadosi, M., Mirbagher Ajorpaz, M., Khorasanifar, L., 2013. The effect of Pilates exercises on general health in women with type 2 diabetes. life Sci. J. 13, 283—287.

Tunar, M., Ozen, S., Goksen, D., Asar, G., Bediz, C.S., Darcan, S., 2012. The effects of Pilates on metabolic control and physical performance in adolescents with type 1 diabetes mellitus. J. Diabetes Complicat. 26, 348—351.

Wang, L.J., Wu, M.S., Hsu, H.J., Wu, I.W., Sun, C.Y., Chou, C.C., Lee, C.C., Tsai, C.R., Tsai, Y.C., Chen, C.K., 2012. The relationship between psychological factors, inflammation, and nutrition in patients with chronic renal failure undergoing hemodialysis. Int. J. Psychiatry Med. 44, 105—118.

Wells, C., Kolt, G.S., Marshall, P., Hill, B., Bialocerkowski, A., 2013. Effectiveness of Pilates exercise in treating people with chronic low back pain: a systematic review of systematic reviews. BMC Med. Res. Methodol. 13, 7.

Werneke, U.1, Goldberg, D.P., Yalcin, I., Ustün, B.T., 2000. The stability of the factor structure of the General Health Questionnaire. Psychol. Med. 30, 823—829.

Williams, A., Manias, E., 2008. A structured literature review of pain assessment and management of patients with chronic kidney disease. J. Clin. Nurs. 17, 69—81.

World Health Organization, 2008. Policies and Practices for Mental Health in Europe, Meeting the Challenges. World Health Organization, Geneva, Switzerland.