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Comparison of the Effect of Aerobic and Resistance Training on Quality of Life of Hemodialysis Patients

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ABSTRACT

Aims Hemodialysis treatment affects the long-term life of the patients. Therefore, most hemodialysis patients have an inactive lifestyle. Inactivity is associated with a high risk of poor quality of life, hospitalization, and mortality among dialysis patients. Therefore, this study aimed to compare the effect of aerobic and resistance training on the quality of life of hemodialysis patients.

Materials & Methods In this clinical trial study, 64 hemodialysis patients of Shahid Beheshti Hospital in Yasuj who were eligible to participate in the study were selected by convenience sampling method. The subjects were randomly assigned into three groups (aerobic exercise, resistance exercise, and control group). Patients in the aerobic exercise group were provided fixed bicycle aerobic exercise for 8 weeks during hemodialysis, and the subjects in the resistance exercise group were provided resistance training by stretches and dumbbells. The control group did not receive any intervention. A demographic questionnaire, Kidney Disease Quality Of Life-Short Form (KDQOL-SF) was used immediately before and after the interventions. Data were analyzed using SPSS 21 through a one-way analysis of variance.

Findings There was no statistically significant difference in the mean score of the public quality of life (p=0.8) and specific quality of life (p=0.2) between the experimental and control groups, before the intervention. There was a statistically significant difference in the public and specific quality of life (p=0.001) between the aerobic and resistance training groups with the control group. However, there was no statistically significant difference in the public and specific quality of life between the aerobic and resistance exercise groups (p>0.05).

Conclusion Both types of aerobic and resistance exercises can be done by the individual as complementary and practical, effective, affordable, and available therapy. Therefore, it is suggested to provide interventions in the educational program for patients undergoing hemodialysis by the health team members.

Keywords Aerobic Exercise; Resistance Training; Hemodialysis; Quality of Life

CITATION LINKS

[1] Quality of life in chronic kidney ... [2] Prevalence of renal damage in ... [3] Anabolic effect of exercise training ... [4] The effects of 6-month physical training ... [5] Creatine monohydrate treatment ... [6] Effects of exercise training plus ... [7] Factors associated with ... [8] Cardiovascular disease and chronic ... [9] Quality of life in patients with chronic ... [10] Physical functioning in end-stage ... [11] Exercise and the patient with ... [12] Physical activity and quality of ... [13] Implementing a theory-based ... [14] Emotion regulation, affect, psychosocial ... [15] Effect of physical exercises on ... [16] Direct pelvic access percutaneous ... [17] The association between intradialytic ... [18] Effects of continuous moderate ... [19] Exercise-based interventions in ... [20] Effectiveness of exercise on fatigue ... [21] Exercise training in adults with ... [22] Intradialytic exercise in hemodialysis ... [23] Dose-response relationship between ... [24] The effect of load reductions on ... [25] Exercise training during hemodialysis ... [26] A rationale for intradialytic exercise ... [27] Comparing the effects of active ... [28] Efficacy and safety of intradialytic ... [29] Benefits of a low intensity ... [30] Intradialytic exercise: A feasibility ... [31] Effectiveness of muscle stretching ... [32] The short form health survey (SF-36) ... [33] Intradialytic virtual reality exercise ... [34] Impact of intradialytic exercise ... [35] The effect of six months aerobic ... [36] Intradialytic exercise improves physical ... [37] Combined resistance and aerobic exercise ... [38] Physical activity and health-related ... [39] Effect of resistance exercise ... [40] Effects of intradialytic exercise ... [41] Hemodynamic response to lower body ... [42] Association between quality ... [43] Hemodialysis patients perceived exercise ...

Introduction

The end-stage renal disease (ESRD) is caused by the gradual and irreversible loss of the kidney. In these patients, the kidneys are unable to excrete toxins from the body due to cellular metabolism, which causes the accumulation of urea, phosphorus, salts, and protein end products in the bloodstream and reduces urination [1, 2]. Hemodialysis is the most common form of renal replacement therapy in 90% of patients with end-stage renal disease [3]. Hemodialysis treatment affects the patient's long life. So, most hemodialysis patients have an inactive lifestyle. Hemodialysis is also performed in a horizontal position, and the person spends approximately 800 hours per year without physical activity [4]. The poverty of movement is associated with a high risk of hospitalization and mortality among dialysis patients [5]. Decreased muscle strength due to catabolism and muscle loss [6, 7] and prevalence of cardiovascular disorders [8] reduces the quality of life and physical function [9]. Decreased physical health is an important cause of inactivity in patients with end-stage renal disease. Therefore, regular exercise and physical activity are beneficial for hemodialysis patients, and the nephrology community should consider recommending the exercises in the procedure of patients' treatment [10]. Quality of life in patients with end-stage renal disease is affected by several factors, including biological, psychological, and social stress. Some of these patients cannot cope with their disease and lose hope for future life [11]. Regular physical activity that has become a habit has been analyzed as a better predictor of quality of life for hemodialysis patients than for healthy individuals [12]. Due to the low quality of life of hemodialysis patients [13], they need to change their adaptive ability to adapt to this new lifestyle [14, 15]. Regular exercise is recommended to correct movement poverty in hemodialysis patients. Aerobic and resistance exercises are recommended for hemodialysis patients [16, 17]. These exercises have beneficial effects on cardiovascular risk factors, treatment of muscle wasting, mental health problems, functional capacity, anemia, fatigue, and improvement their public health [18-20]. Aerobic exercise increases cardiac output, and oxygen consumption, and decreases systemic vascular resistance. There is an increase in venous return during aerobic exercise, which is probably caused by a sympathetic vascular contraction in high-capacity veins as well as the muscle contraction pump increases the volume of the diastolic end. This effect is more pronounced if the exercise is done while sleeping. The complex hemodynamic and neurohormonal response to aerobic exercise increases oxygen transport and absorption by active muscles [15, 21, 22]. Resistance causes muscle contraction in the opposite direction of an external resistance factor such as dumbbells or bodyweight [23]. Some researchers believe that resistance training aims to improve muscle strength and endurance [24]. From a physiological point of view, exercise during dialysis by increasing muscle blood flow and increasing the level of open capillaries can increase the excretion of urea and other toxins from the tissues into the vascular system and then excretion through dialysis [25, 26]. Exercise also decreases serum levels of phosphorus and potassium. In addition, active and inactive exercises can significantly improve patients' quality of life [27]. Exercise during dialysis improves the quality of life of hemodialysis patients [28]. Even in one study, a low-intensity physical exercise program in elderly patients over 80 years old improved muscle strength, functional capacity, depressive symptoms, and health-related quality of life in hemodialysis patients [29]. Regular physical exercise improves the physical and mental health of these patients and increases their quality of life [30]. Assessing the quality of life in patients with chronic renal disease is an ideal index of the outcome of exercise intervention in these patients [31]. Despite the low quality of life of hemodialysis patients, there is no complete research comparing the effect of exercise on the quality of life in hemodialysis patients in Iran. Therefore, this study aimed to compare the effect of aerobic and resistance exercises on the quality of life in hemodialysis patients.

Methods

This study is a clinical trial that has been registered on the website of the Iranian Clinical Trials Registry with the code IRCT20190120042436N2. This study was carried out on the patients referred to the dialysis ward of Shahid Beheshti Hospital in Yasuj, Iran from 2018 to 2019. All samples met the inclusion criteria. Out of 80 subjects, 64 hemodialysis patients were selected by convenience sampling method according to the inclusion criteria. The samples were allocated into three groups including aerobic exercise (n=23), resistance exercise (n=20), and control (n=21) using random block allocation. Inclusion criteria included having at least 6 months of dialysis history at least 2 times per week. The exclusion criteria were lack of known ischemic disease history, no history of myocardial infarction and angina pectoris during the last 6 months, lack of lung disease that requires artificial oxygen, lack of stroke or transient ischemic attacks history in the past 3 months, no disorder in the musculoskeletal system of the legs that prevent the desired exercise (pedaling with a bicycle), lack of use of beta-blocker, lack of uncontrolled blood pressure and synchronized with other intervention.

A demographic questionnaire and Kidney Disease Quality of Life -Short Form (KDQOL-SF) were used for data collection. This questionnaire was designed by the International Organization for Quality of Life, which measures the quality of public life (36 items)

and specific life (43 items) of the patients. Scoring is conducted using the three-point scale with scores of 0, 50, 100, and five-point scale with scores of 0, 25, 50, 75, 100, and six-point scale with scores of 0, 20, 40, 60, 80, and 100, which a high score indicates a better quality of life. The public quality of life of the questionnaire has 8 subgroups including public health, physical function, restrictions on role-playing due to physical problems, restrictions on role-playing due to emotional disorders, social function, physical pain, headache, and mental health. The specific quality of life includes 11 dimensions of the renal solute load, social interactions, cognitive function, symptoms and problems, renal function, sexual function, social support, occupation status, motivation, patient satisfaction, and sleep status. The validity and scientific reliability of the quality of life questionnaire has been confirmed by Iranian and foreign studies. The validity and reliability of the Persian version of this questionnaire were confirmed in 2005 by Montazeri *et al*., and Cronbach's alpha is reported to be 0.65 [32].

The necessary ethics license was obtained from the Research Ethics Committee of Yasuj University of Medical Sciences. Patients' informed and written consent was obtained before the intervention and after fully explaining the aim of the study. Also, the confidentiality of information, voluntary participation in the study, and free withdrawal at any stage of the study were emphasized. In the first 2 hours of dialysis, exercises were performed on the patient's bed according to the specific protocol of each intervention. In the aerobic intervention group, patients underwent aerobic exercise for 15 weeks during hemodialysis for 15-60 minutes (including warm-up and cool down at the beginning and end of exercise) using a Manoli MB 120 stationary bicycle made in Taiwan and assembled in Iran (Table 1). The exercise duration in the first sessions during hemodialysis started at 15 minutes for all patients, and in the seventh and eighth sessions, it was increased to 60 minutes. In the intervention group, resistance exercises were provided for 15-60 minutes using trampolines and dumbbells. As in the aerobic exercise group, the first sessions started with 15 minutes for all patients and increased to 60 minutes in the seventh and eighth sessions. Warm-up by simple stretching movements in all 4 groups of muscles was performed in the form of flexion and extension of the elbow joint, moving to the sides, and raising and lowering the arm using a stationary bike with low intensity. After warming up for 5 minutes, exercise was performed for 15-60 minutes. The exercise started for the first week by opening and closing the arm with dumbbells (one maximum repetition). Then 60 to 65% of the above weight was gained and 3 training sessions were provided. The number of repetitions of the exercise was 8 to 10 times. The rest time was 1 to 3 minutes after each exercise. The exercises for the following weeks have been presented in Table 1. The duration of resistance training started from 12-15 minutes in the first weeks and ended in 36-48 minutes in the seventh and eighth weeks. During this time, the cramping pain (especially in the first sessions), blood pressure, and changes in the patient's public condition were checked, and the exercises were stopped in case of problems. The exercise began as soon as the symptoms disappeared after rest, and if the above symptoms were repeated, the exercises in the session would be stopped. The exercise was also monitored by the nurse in charge. The control group received no intervention, however, the benefits of exercise were explained to them.

Data were collected before and after the intervention. Data were analyzed using SPSS 21 with a significant level of 0.05. The descriptive findings of the study were examined by absolute and relative frequency, mean standard deviation, and standard range. One-way analysis of variance was used for data analysis.

Table 1) Aerobic and resistance exercise interventions

Intervention Variables	1st and 2nd week	3rd & 4th week	5th & 6th week	7th & 8th week
Aerobic exercise				
Training intensity (%HR_{max})	30-50	30-50	40-55	40-55
Number of training courses	4	6	8	10
Duration of each training session (minutes)	2	2	3	3
Number of rest periods	3	7	8	9
Duration of each break (minutes)	1-2	1-2	1-2	1-2
Total training time per session (minutes)	15-20	20-25	30-40	40-50
Resistance exercise				
Exercise intensity (1 maximum repetition)	60-65	65-70	70-75	75-80
Number of training courses	3	3	3	3
Number of exercise repetitions	8-10	8-10	10-12	10-12
Rest period (minutes)	1-3	1-3	1-3	1-3
Warm up (minutes)	5	5	5	5
Cool down (minutes)	5	5	5	5
Total training time per session (minutes)	12-15	20-24	30-40	36-48

Findings

All of the subjects participate in the study until the end of the intervention. The mean age of patients was 59±13, which showed a significant difference between all three groups ($p<0.05$) which showed a significant difference. Also, there wasn't a difference between the study groups in terms of gender, occupation, education level, body mass index, filter clearance, ultrafiltration, hemodialysis flow rate, frequency and duration of dialysis, hemoglobin, and hematocrit, and pump speed ($p>0.05$). Before analyzing the outcome variables, the status of their

distribution was examined. The data followed a normal distribution. The bootstrap technique was also used in the analysis of outcome variables. In the intergroup study before the intervention, a significant difference was observed between the study groups in the mean scores of the public quality of life in the dimensions of physical function, restriction on role-playing due to physical problems, restriction on role-playing due to emotional disorders, social function, perception of public health and physical pain; however, no significant difference was observed between the groups after the intervention (p<0.5). A comparison of the mean differences by Post Hoc test showed the differences between the two intervention groups (p<0.5). However, the comparison of mean scores of the public quality of life and mental health showed a significant difference between the intervention groups before and after intervention (p>0.5; Table 2).

Table 2) Comparison of mean±SD scores of public quality of life dimensions before and after the intervention between three groups (n=64)

Variable	Aerobic Exercise	Resistance exercise	Control	p.
Physical function				
Before	31.14±9	23.19±5.9	20±28	0.3
After	58.14±7.3	54.29±5.5	32.23±4.3	0.001
Restriction on role playing due to the physical problem				
Before	15.22±21.28	12.25±5	18.16±5.7	0.65
After	52.27±2	41.39±25.96	26.22±7.2	0.004
Restriction on role-playing due to emotional disorders				
Before	33.20±3.1	31.17±66.01	28.15±6.9	0.6
After	66.26±7.5	48.25±3.3	28.24±5.3	0.1
Vitality				
Before	47.10±39.09	6±52.1	51.15±19.15	0.3
After	53.12±9.6	57.8±2.5	52.14±14.7	0.4
Mental health				
Before	53.10±9.52	54.8±8.81	49.14±52.22	0.3
After	51.10±1.1	50.7±8.3	11±52.5	0.9
Social function				
Before	23.14±36.74	18±20.3	20.18±23.7	0.7
After	63.17±5.2	47.18±5.4	18.18±45.79	0.001
Perceived public health				
Before	31.11±7.4	27.11±29.89	31.14±15.88	0.4
After	56.13±7.9	11±51.1	32.15±34.01	0.001
Physical pain				
Before	21.14±95.38	22.16±5.6	20.14±2.8	0.8
After	64.23±7.7	47.20±1.9	25.21±2.3	0.001
Public quality of life				
Before	35.2±7.6	35.6±7.53	30.7±94.87	0.001
After	58.8±45.01	49.8±73.01	33.8±47.81	0.001

The findings showed a significant difference in the public quality of life before and after intervention between the aerobic and resistance groups except for the mental health subgroup (p<0.05; Table 3). There was no difference in the mean scores of the public quality of life in the study groups before the intervention (p=0.08). However, a significant difference was observed between the mean scores of the public quality of life in the subjects of the study groups (p=0.001). According to the observed differences, a post hoc test was performed using the Scheffe test, assuming equality of variance and correction coefficient (0.016=3.005). The results showed a statistically significant difference in the mean scores of the public quality of life between the two intervention groups with the control group after the intervention (p=0.001). There was no statistically significant difference between the two intervention groups according to the Bonferroni correction coefficient (p=0.026). Intergroup analyses showed a significant difference between the three groups in specific quality of life dimensions, including renal load, social interactions, cognitive function, symptoms and problems, renal function, sexual function, and sleep, after the interventions. The comparison using the Scheffe test showed a difference in the two intervention groups compared to the control group (p<0.05). However, comparing the scores of the dimensions of the specific quality of life in the dimensions of social support, work status, patient satisfaction, and encouragement did not show a statistically significant difference (p<0.05; Table 4). In the group study, the findings showed a statistically significant difference between the mean dimensions of the specific quality of life after the intervention compared to before in each of the two groups of aerobic and resistance exercise except for the subscales of occupation status, social support and patient satisfaction (p<0.05; Table 5). There was no significant difference in the mean scores of the specific quality of life of hemodialysis patients in the three groups before the interventions (p=0.02). However, after the interventions, a significant difference was observed in the mean of the total scores of the specific quality of life of hemodialysis patients in the three groups (p=0.001). According to the observed differences, a post hoc test was performed using the Scheffe test assuming equality of variance and correction coefficient (0.016=3.005). The results showed that patients in the two intervention groups had a statistically significant difference in the mean scores of the specific quality of life after the intervention (p=0.001), but there was no significant difference between the patients of the intervention group (p=0.4).

Table 3) Intragroup comparison of dimensions of the public quality of life of dialysis patients after interventions compared to before

Dimension	Aerobic Exercise		Resistance Exercise		Control	
	Mean dif.	p.	Mean dif.	p.	Mean dif.	p.
Physical function	26.14±7.3	0.001	21±31.25	0.001	4.50±28.97	0.004
Restriction on role playing due to physical problem	36.23±95.68	0.001	28.32±75.72	0.001	8.18±09.06	0.052
Restriction on role playing due to emotional disorders	33.30±33.15	0.001	16.22±66.94	0.004	0.621±0.08	1
Vitality	6.10±52.16	0.006	5.8±25.18	0.01	0.20±95.01	0.04
Mental health	-1.11±9.3	0.4	-10.00±4.62	0.1	2.60±47.63	0.1
Social function	40.18±21.05	0.001	27.20±5.11	0.001	1.40±7.48	0.08
Perceived public health	11±25.7	0.001	23.11±75.47	0.001	1.70±19.81	0.46
Physical pain	42.25±78	0.001	24.22±67.08	0.001	5.15±2.25	0.1
Public quality of life	22.11±75.7	0.001	14.10±03.11	0.001	2.60±53.7	0.1

Table 4) Intergroup comparison of mean±SD scores of the specific quality of life dimensions before and after interventions

Variable		Aerobic Exercise	Resistance exercise	Control	p-value
Renal load	Before	13±23.4	23.13±1.1	17.11±3.5	0.2
	After	54.15±1.2	50.24±31.9	21.9±1.5	0.001
Social interaction	Before	54.18±20.8	51.19±0.25	59±45	0.2
	After	65.17±79.5	53.14±33.66	49.17±2.4	0.004
Cognitive function	Before	62.9±3.7	63.13±3.7	56.19±50.50	0.2
	After	71.13±3.6	65.14±33.11	59.19±4.58	0.05
Symptoms and problems	Before	43.13±6.9	38.16±64.66	35.18±71.39	0.2
	After	71.13±9.6	65.9±3.8	37.18±10.98	0.001
Renal function	Before	26.12±7.1	32.14±5.2	27.12±7.5	0.3
	After	46.13±8.3	45.13±15.8	28.12±3.5	0.001
Sexual function	Before	15.15±8.8	13.10±2.9	15.14±1.1	0.2
	After	33.18±3.7	20±25.1	19.18±1.3	0.01
Sleep	Before	37.18±4.7	15±39.16	38.16±5.1	0.9
	After	54.16±2.1	50.12±8.7	40.18±37.03	0.02
Social support	Before	45.32±6.6	41.30±7.3	43.24±7.4	0.9
	After	47.32±8.3	46.30±7.8	25±46.7	0.9
Occupation status	Before	26.44±08.89	36±15.63	4.15±7.03	0.137
	After	26.44±0.889	36±15.663	4.15±7.03	0.137
Encouragement	Before	99.2±45.60	99.2±37.79	97.6±02.7	0.138
	After	99.2±45.6	0±100	98.3±8.7	0.363
Patient satisfaction	Before	0±100	0±100	100±0	0.0001
	After	0±100	0±100	0±100	0.0001
The specific quality of life	Before	46.2±12.3	45.11±6.71	40.12±76.60	0.001
	After	62.4±12.6	57.12±5.68	42.12±8.86	0.001

Table 5) Intragroup comparison of the mean differences between the dimensions of the specific quality of life of in the three groups after the interventions

The specific quality of life	Aerobic Exercise		Resistance Exercise		Control	
	Mean dif.	p.	Mean dif.	p.	Mean dif.	p.
Renal load	31.13±8.17	0.001	27.19±18.47	0.001	3.6±86.98	0.02
Social interaction	11.8±59.57	0.001	2.12±33.28	0.4	4.11±12.44	0.1
Cognitive function	9.15±01.4	0.01	1.12±99.25	0.047	2.7±53.44	0.1
Symptoms & problems	28.13±26.98	0.001	26.14±66.8	0.001	1.2±38.89	0.40
Renal function	20.13±11.1	0.001	12.10±65.75	0.001	0.8±59.18	0.7
Sexual function	17.11±5.37	0.001	11.11±8.70	0.001	3.8±94.38	0.50
Social support	2.7±1.6	0.182	7±5.83	0.01	2.5±35.91	0.08
Occupation status	0.000	0.000	0.000	0.000	0.000	0.000
Encouragement	0.000	0.000	0.2±62.79	0.33	1.5±78.97	0.1
Patient satisfaction	0.000	0.000	0.000	0.000	0.000	0.000
Sleep	11.38	0.001	11.10±87.06	0.001	1.6±8.68	0.1
Total score of specific quality of life	16.4±25.5	0.001	11.3±8.31	0.001	2.1±04.54	0.1

Discussion

Despite the high prevalence of movement poverty, inadequate dialysis, and low quality of life of hemodialysis patients and the resulting problems, no study was found to compare the effect of exercise on the quality of life in hemodialysis patients. There is not even an effective way to improve the care of these patients and their quality of life in medical centers. Therefore, this study was performed to compare the effect of aerobic and resistance exercise on the quality of life of hemodialysis patients. In the present study, both aerobic and resistance exercise interventions significantly improved the mean score of the specific and public quality of life.

Segura Orti & Testal García compared virtual reality exercise with normal exercise in the last half hour of hemodialysis. They found that virtual reality exercise was safe during hemodialysis and could improve physical function and health-related quality of life, and can be performed safely at the end of the hemodialysis session [33]. In the mentioned study, although no resistance training was performed and the executive protocol was different, exercise improved the quality of life of patients. Brown *et al*.

concluded that exercise during dialysis increases the effectiveness of dialysis [34]. The mean scores of the public quality of life in physical function, restriction in role-playing due to physical problems, restriction in role-playing due to emotional disorders, physical pain, social function, and perception of public health significantly improved compared to the control group after aerobic and resistance training. However, there was no significant improvement in vitality and mental health parameters. The adherence of the subjects is one of the influential factors in the study, which was possible to evaluate the adherence to the interventions in this study. Because the researcher was present in all training sessions and controlled the performance of exercises by the subjects. A possible reason for the lack of results in some subscales may be the duration of the intervention, which was 8 weeks. Fathi & Hejazi indicated the positive effects of aerobic exercise as a non-invasive and non-pharmacological method with minimal side effects, which can be effective to improve the performance of all hemodialysis patients. Therefore, for this reason, this method can probably be used to improve the condition of hemodialysis patients [35]. Also, the scores of the specific quality of life dimensions (renal load, social interactions, cognitive function, symptoms and problems, renal and sexual function, sleep) in each of the groups under aerobic and resistance exercises showed a significant improvement compared to the control group after the interventions. However, the scores on some aspects of the specific quality of life (social support, work status, staff encouragement, and patient satisfaction with staff) did not show a significant improvement. One of the possible reasons for the lack of results in some dimensions is that due to the disability of most hemodialysis patients, these patients were unable to work and provide living expenses. Therefore, this intervention did not affect their occupation status, social support, and job encouragement.

The present study showed that the type of aerobic and resistance training had no different effect on the quality of life of hemodialysis patients. Rhee *et al*. showed significant effects of aerobic and anaerobic exercise on joint pain, physical health status, blood pressure during dialysis, depression, and mental health during dialysis [36]. However, aerobic and resistance training in the present study could not reduce depression and increase mental health and quality of life in hemodialysis patients. One of the differences between the Rhee study and the present study was the combination of aerobic and resistance exercises in the mentioned study and separately aerobic and resistance exercises in our study. Orchy *et al*. compared the effect of combined aerobic and resistance training with resistance training alone on the physical function of hemodialysis patients. They concluded that a combination of aerobic and resistance training has a considerable effect on the physical performance of hemodialysis patients than resistance training alone [37]. The results of the Orchy study are in line with the present study, and the difference is that Orcy *et al*. [37] compared only physical function; however, in the present study, all the parameters of quality of life were studied. The second difference was the executive protocol of the intervention and the comparison of quality of life of the adequacy of dialysis between the two groups. The time and level of exercises in this study started from the low and gradually increased, whereas, in the study by Orcy *et al*. the duration of the exercises was stable, and just the level of physical performance was increased [37]. Wu *et al*. confirmed the positive effect of moderate-intensity exercise on the quality of life of hemodialysis patients [38].

The results showed a similar effect of aerobic and resistance training on the quality of life of hemodialysis patients. Both interventions have improved the specific and public quality of life. In the study by Segura-Orti *et al*., resistance exercise has a higher effect on the physical performance of patients with hemodialysis than aerobic exercise, but no difference was observed in the quality of life of the two groups [39]. Segura-Orti *et al*. compared the effect of aerobic and resistance exercise on physical performance and quality of life of hemodialysis patients, which was following the methods of the present study. However, the differences between the mentioned study and the present study are that the executive protocol of aerobic exercise in the mentioned study was performed through low intensity and constant time. Whereas, in the present study, the duration and level of exercise started from the low intensity and gradually increased. One of the strengths of the above study was the intervention duration, which was 30 weeks. However, this was not possible in the present study due to the time limitation.

The findings showed an increase in the quality of life of hemodialysis patients due to aerobic exercise. Ouzouni Stavroula *et al*. showed that exercise during dialysis improves physical function and mental health in hemodialysis patients [40]. Nette *et al*. described that exercise improves fluid circulation and lowers blood pressure, muscle spasms, and bruising after dialysis. Then the closure of the arteries around the muscle fascia and accumulation of metabolites cause cramps and consequently cause coldness and immobilization of muscles during hemodialysis and lack of oxygen in the muscular system. Therefore, exercise prevents the muscle's coldness, clears the metabolites from the muscle, and relieves the pain by increasing blood flow. Therefore, the quality of life of the patients increases because of reduced pain [41].

The results showed an increase in the quality of life of hemodialysis patients due to resistance training. Li *et al*. found that increasing physical activity reduces anxiety and depression and increases the quality of

life in the patients [42]. Filipčič *et al*. also confirmed interventions to increase the physical activity of hemodialysis patients and its benefits to improve their quality of life [12]. Ghafouri Fard *et al*. consider providing exercise facilities, encouraging patients to participate in exercise programs, and the use of sports specialists in hemodialysis centers as a significant help to encourage hemodialysis patients to exercise regularly [43].

The limitations of this study were the time restriction to perform exercise intervention and the use of aerobic and resistance exercises separated. The strong point of the study was the researcher's presence in all sessions of the interventions and monitoring of the exercise interventions.

According to the findings, it is suggested to increase the duration of the study in future studies, and evaluate the effects of the exercises on other problems of hemodialysis patients, including fatigue, daily activities, sleep quality, and restless legs syndrome. It is suggested that the relevant authorities in addition to providing the necessary equipment in the dialysis ward, also consider the continuous training of nursing staff to improve the health of patients undergoing hemodialysis.

Conclusion

Both types of aerobic and resistance exercises can be done by the individual as complementary and practical, effective, affordable, and available therapy. Therefore, it is suggested to provide interventions in the educational program for patients undergoing hemodialysis by the health team members.

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