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RESEARCH ARTICLE

Comparison of the efficacy of intradialytic core stabilization and aerobic exercises for hemodialysis patients: randomized controlled single-blind study

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ABSTRACT

Purpose: This study was performed to investigate and compare the effects of intradialytic core stabilization and aerobic exercises on physical performance, fatigue, quality of life and dialysis adequacy.

Materials and methods: The study involved 39 individuals on hemodialysis randomized into two groups: aerobic exercise (AE, $n=20$) and core stabilization (CSE, $n=19$). Over 8 weeks, the AE group performed pedal ergometer exercises, while the CSE group performed 4-phase core stabilization exercises. Physical performance (five times sit to stand test, 2-min step test), quality of life (Kidney Disease Quality of Life-36; KDQOL-36), fatigue levels (Piper Fatigue Scale), and dialysis adequacy (Kt/V and URR) were assessed.

Results: After training, a significant improvement was observed in the physical performance, fatigue levels, and some parameters of KDQOL-36 of the patients ($p<0.05$). However, no significant changes were observed in dialysis adequacy indicators (Kt/V and URR) ($p>0.05$). When the amount of development obtained in both treatment groups is compared, kidney disease burden only in the subparameter of KDQOL-36 was statistically significantly improved in the CSE group compared to the AE group ($p<0.05$).

Conclusions: According to the results of the study, intradialytic core stabilization exercises appear to have similar effects to aerobic exercises and can be performed by HD patients.

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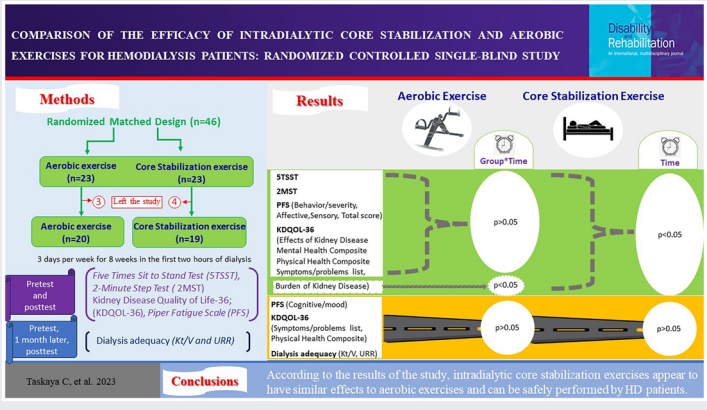
➤ IMPLICATIONS FOR REHABILITATION

- Core stabilization exercises and aerobic exercises performed during dialysis are well tolerated by hemodialysis patients.
- Over eight weeks, intradialytic core stabilization and aerobic exercises are effective in improving physical performance, fatigue level, and quality of life in hemodialysis patients.
- In hemodialysis patients, eight weeks of intradialytic core stabilization and aerobic exercises are not sufficient to improve dialysis adequacy.
- It is recommended to include intradialytic core stabilization and aerobic exercises in the rehabilitation of hemodialysis patients.

GRAPHICAL ABSTRACT



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Introduction

End-stage renal disease (ESRD), the final stage of chronic kidney disease with irreversible loss of renal functions, is an emerging global public health problem [1]. For ESRD, treatments to control hypertension, diabetes and their renal complications are implemented [2]. Though these implementations increase patient quality of life, in ESRD the only choices to treat the disease are renal replacement therapy (RRT); in other words, hemodialysis (HD), peritoneal dialysis (PD) and kidney transplantation [3]. Globally, the most frequently used treatment for RRT is HD [4].

HD is a treatment method used to provide fluid-electrolyte balance and remove waste, and complications due to ESRD disease itself may develop [5]. Additionally, immobilization of patients due to the frequency and long duration of dialysis sessions causes significant falls in muscle strength, balance problems and loss of functional capacity [4,6].

Most dialysis units do not perform physical activity assessment and exercise counseling. As a result, the question of which strategies should be developed to safely and effectively implement exercise programs in dialysis units emerges [7]. Exercises may be performed on intradialytic or non-dialysis days. In HD patients, intradialytic exercise is recommended within the first 2 h of dialysis to prevent acute complications [8,9]. Studies reported that exercise in ESRD patients may reduce HD complications, increase aerobic and walking capacity and quality of life [10–12]. The most common intervention types for HD patients are aerobic exercise, a combination of aerobic and resistance exercise, and resistance exercise alone, in that order. Additionally, HD patients are recommended regular exercise 3 times per week with each session lasting at least 20 min to improve physical fitness, cardiovascular measures and health-related quality of life [13].

Though planning exercise to prevent complications and to increase quality of life is recommended for HD patients and though it is accepted that intradialytic aerobic exercises may safely be performed by HD patients, the superiority of exercise types for these patients is still not clear [14,15]. Additionally, research into the effects of training with different exercises in HD patients has attracted relatively less attention compared to aerobic exercise. Most of this research appears to assess the short-term effects of training and mainly provided peripheral muscle training [14,16–20]. When the literature is investigated, there is no study encountered which investigates the efficacy of intradialytic core stabilization exercises. As a result, this study aimed to compare the efficacy of intradialytic core stabilization and aerobic exercises in HD patients. In this study, the effects of intradialytic core stabilization and aerobic exercises on physical performance, fatigue, quality of life and dialysis adequacy hemogram values were researched in HD patients.

Methods

Design

The research was designed as a randomized, controlled, single-blind study. The study began after receiving permission dated 04.07.2022-55528 and numbered 54 from the Scientific Research and Publication Ethics Committee. Written consent was obtained from patients accepting participation in the study. The study was registered with ClinicalTrials.gov (NCT05534542).

Participants

The study began with 46 patients accepting participation in the study and meeting the inclusion criteria, among 104 patients with ESRD diagnosis from a nephrologist (CH) and receiving HD treatment in a dialysis unit. Inclusion criteria were receiving 4-h HD treatment on 3 days per week for at least 6 months, age 18 and over and receiving 3 or lower points on the Sarcopenia Screening Test (SARC-F). Exclusion criteria were myocardial infarctus history within the last 3 months, angina pectoris, uncontrolled arrhythmia or uncontrollable hypertension, communication and/or cognitive problems at levels where the requirements of the tests could not be fulfilled, psychiatric diagnosis, orthopedic problems preventing exercise, and approaching travel or kidney transplantation plans.

Patients were randomly allocated to the aerobic exercise (AE) and core stabilization exercise (CSE) groups. Randomization was based on sex, and used the randomized matched design. Patients accepting participation in the study were requested to select their group by choosing from enclosed envelopes and the patient was included in the group written inside the envelope. The next patient with the same sex was allocated to the other group. After randomization, the AE group included 23 patients, while the CSE group included 23 patients. During the study, 3 people in the AE group and 4 people in the CSE group did not complete the study. The study was completed with 20 people in the AE group and 19 people in the CSE group (Figure 1).

Interventions

In both groups, exercises were performed in the first 2 h of 4-h dialysis during HD on 3 days per week for 8 weeks under observation by a physiotherapist (CT). Based on perceived subjective fatigue degree and according to the 6-20 Borg scale, an exercise program was followed with maximum fatigue level of 12–16 [21].

During HD, the AE group used a pedal ergometer for 20 min while lying supine on the treatment bed. Before and after exercise, 3–5 min warm-up and cool-down were performed with low speed pedal ergometer (Figure 2). In the CSE group, exercises were performed in 4 phases, with phases implemented for two weeks. The first 3 phases of training were applied during HD on the treatment bed in supine position. The fourth phase was performed in sitting position on the edge of the treatment bed (Figure 3). The target was to perform exercises with 10 repeats. In the first phase, the patient lay in supine position with knees bent and feet flat on the bed and performed transversus abdominis (TrA) muscle activation and held the position for 10 s. Second phase exercises comprised TrA muscle activation along with lower and upper extremity exercises. Third phase exercises comprised completing phase II exercises with a yellow TheraBand. In the fourth phases, lower and upper extremity exercises were performed in sitting position with a yellow TheraBand (Table 1). To prevent complications of exercise and ensure continuity of HD, exercises were not performed for the extremity where the AVF was located [22,23].

Assessments

Demographic and clinical features of patients (age, sex, HD treatment duration, chronic renal failure (CRF) duration, primary cause of CRF and comorbidities) were recorded. Then clinical assessments began. Assessment of patients was performed before exercise and after 8 weeks of exercise by a different physiotherapist (ÖB) to the physiotherapist monitoring the exercises. The physiotherapist performing the assessment was not given information about which group the patient belonged to and which exercises they performed.

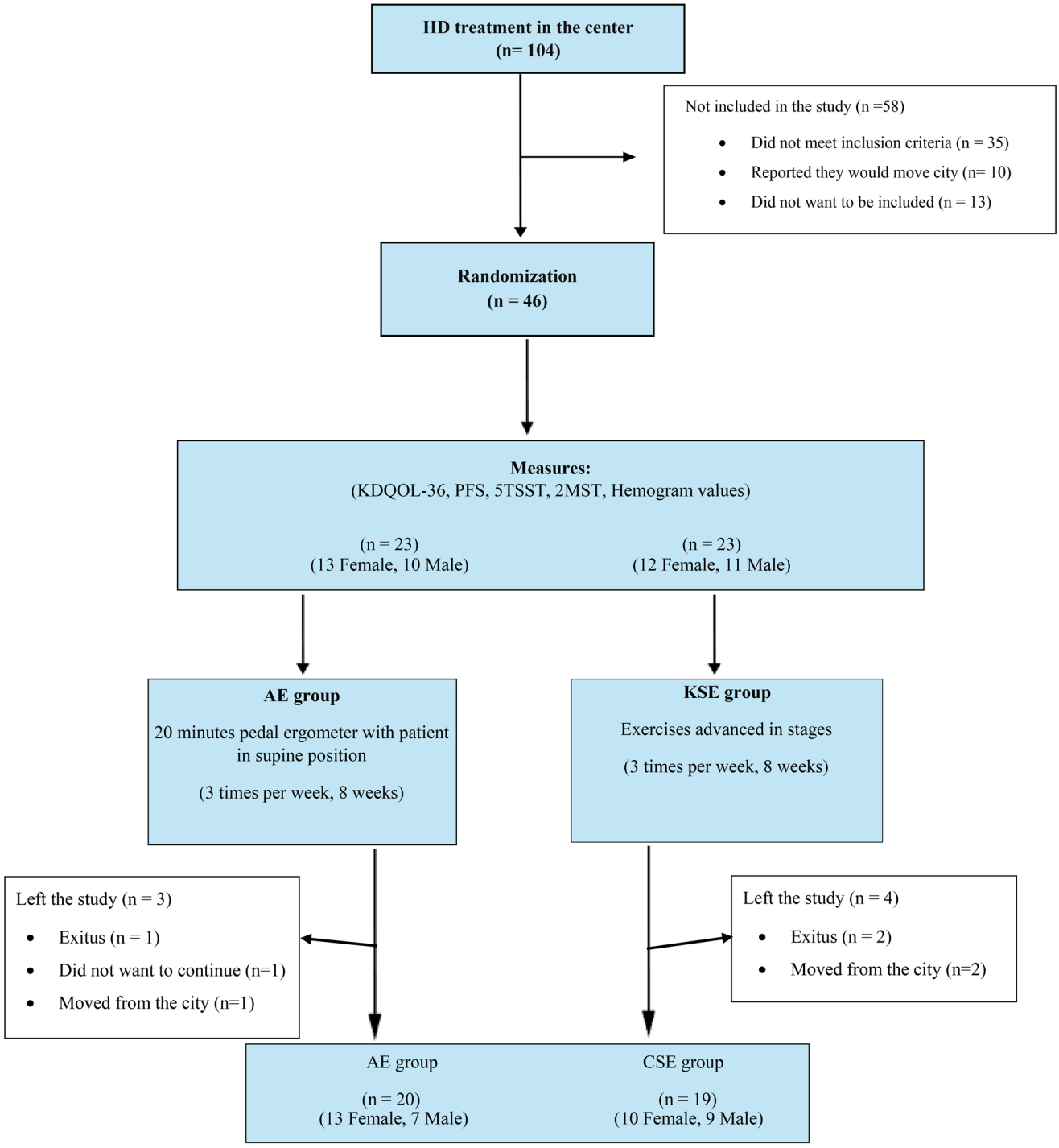

Figure 1. Flow scheme for the study.

Evaluation of physical performance

Assessment of physical performance of patients used the five times sit to stand test (5TSST) and 2-min step test (2MST). Physical performance tests were performed before patients began HD treatment. The 5TSST is a functional method used to assess lower extremity muscle strength. The patient sits on a standard chair with back supported and crosses their upper extremities with hands on their shoulders to begin the test. When the implementor gives the command, the patient is requested to stand and sit on the chair again 5 times sequentially as rapidly as possible. The duration from when the patient first stands up to when their back meets the back of the chair on sitting for the last time is measured with a chronometer and recorded in seconds [24,25]. The 2MST is a practical test used to assess aerobic endurance. Before performing the test, the midpoint between the patella and crista iliaca is determined by measuring while the individual stands in vertical position. The tested individual steps by bringing their knees to the determined height as rapidly as possible for 2 min. Participants are requested to begin the test with the right foot, and are permitted to hold onto a support if required to keep their balance. The performance criterion for the test is defined as the number of steps on the right side completed within 2 min.

Figure 2. Aerobic exercises.

Figure 3. Core stabilization exercises.

Table 1. Group II core stabilization exercises.

Phase I exercises (weeks 1–2)	Phase II exercises (weeks 3–4)	Phase III exercises (weeks 5–6)	Phase IV exercises (weeks 7–8)
Supine position	**Supine position**	**Supine position, resistance with yellow TheraBand**	**Sitting position, resistance with yellow TheraBand**
TrA activation • 10 repeats • Hold for 10 s	***TrA activation + lower extremity mobilization exercises***	***TrA activation + lower extremity mobilization exercises***	***Lower extremity mobilization exercises***
	• Ankle dorsi/plantar flexion • Hip and knee flexion/extension • Hip abduction/adduction • Straight leg lift+	• Ankle dorsi/plantar flexion • Hip and knee flexion/extension • Hip abduction/adduction • Straight leg lift+	• Ankle dorsi/plantar flexion • Hip flexion/extension • Knee extension/flexion+
	TrA activation + upper extremity mobilization exercises *(extremity without fistula)*	***TrA activation + upper extremity mobilization exercises*** *(extremity without fistula)*	***Upper extremity mobilization exercises*** *(extremity without fistula)*
	• Shoulder flexion/extension • Shoulder abduction/adduction	• Shoulder flexion/extension • Shoulder abduction/adduction	• Shoulder flexion/extension • Shoulder abduction/adduction

Note: TrA: transversus abdominus.

Steps that do not meet the desired height are invalid. If the participant cannot reach the required height for a duration, they are requested to slow down or stop and continue when ready, without stopping the time [26].

Assessment of fatigue

Assessment of fatigue levels of patients used the Piper Fatigue Scale (PFS). The PFS was developed by Piper et al. in 1987 with the aim of investigating variability of fatigue symptoms in healthy and patient populations [27]. The patient's subjective perception of fatigue is assessed in four subdimensions of behavior/severity (items 2–7), affect (items 8–12), sensory (items 13–17) and cognitive/mental (items 18–23). An increase in points indicates an increase in fatigue levels. Five important items for assessment of data related to fatigue (1 and 24–27) are not used to calculate fatigue scores [28,29].

Assessment of quality of life

The Kidney Disease Quality of Life-36 (KDQOL-36) was used to assess quality of life of patients. The KDQOL-36 is a valid scale including disease-specific questions used to assess quality of life of kidney patients. The scale includes 36 items and 5 subdimensions. Each dimension is scored from 0 to 100 and high points indicate better health-related quality of life [30,31].

Assessment of dialysis adequacy

To determine the adequacy of dialysis in HD patients, blood samples were taken before treatment, at 1 month and after treatment. Kt/V was investigated, a commonly used tool to assess dose of dialysis. Here K is the urea clearance coefficient of the dialysate (mL/min), t is the dialysis duration (min) and V represents the volume of blood cleared of urea during one dialysis session and is the urea distribution volume [32]. The National Kidney Foundation recommends minimum Kt/V of 1.2 [33]. Additionally, the urea reduction rate (URR) was assessed in the study. URR is another measure of the dialysis dose transferred. The URR rate should be above 55–65% in a HD session [34].

Sample size

To determine the sample of the study, the G *Power program, version 3.1.9.4 (Heinrich Heine University, Düsseldorf, Germany) was used [35]. According to previous studies, the effects of exercises on the Kt/V were determined to be from small to moderate (Cohen's d: 0.05–0.33) [36,37]. To achieve 80% statistical power (1 - β error probability) with an α error level probability of 0.05 and an anticipated correlation of $r = 0.18$ between repeated measurements over time. We conducted repeated measure analysis of variance (ANOVA) with time and between factor interaction, to detect a medium effect size of 0.30 to for the interaction. Using two measurements for the primary outcome, the program generated a sample size of 38. Considering the anticipated dropout rate of 15% and aiming to increase the statistical power of the results, a total of 46 participants were recruited for the study.

Statistical analysis

Statistical analyses were performed using SPSS version 25 software. Fit of variables to normal distribution was investigated using visual (histogram and probability graphs) and analytical methods (Shapiro-Wilk test). Descriptive analyses are given as mean and standard deviation for variables with normal distribution. Nominal variables are given as number and %. The chi-square test (Pearson chi-square) was used to investigate the correlations between categoric variables. To assess variations over time for variables measured in the aerobic and core stabilization groups and group-time interactions, the mixed design repeated measures two-way analysis of variance was used. Statistical significance was determined with total type 1 error level 5%.

Results

A total of 39 subjects (16 men and 23 women) participated in the research. The sociodemographic and clinical features of AE and CSE groups are shown in Table 2. There was no statistically significant difference in terms of demographic and clinical variables between the AE and CSE groups ($p > 0.05$). This result shows the groups were similar in terms of the distribution of sociodemographic and clinical features (Table 2).

The time and time-group comparisons for all subparameters of the 5TSST, 2MST, PFS and KDQOL-36 measurement data in the AE and CSE groups are given in Table 3. There were statistically significant variations in the change over time for 5TSST and 2MST measurement data ($p < 0.05$). For the PFS subparameters, apart from cognitive/mood, the variation over time was found to be statistically significant ($p < 0.05$). The change over time for effects of kidney disease, burden of kidney disease and mental health

Table 2. Comparison of demographic and clinical features of the groups.

Variable		AE ($n=20$) X ± SD		CSE ($n=19$) X ± SD		Total X ± SD		t	p
Age (years)		57.35 ± 11.50		55.53 ± 15.71		56.46 ± 13.56		0.415	0.680*
Hemodialysis treatment duration (months)		47.25 ± 43.65		31.78 ± 38.45		39.26 ± 41.12		1.154	0.256*
CRF duration (months)		103.80 ± 77.01		99.37 ± 61.03		101.64 ± 68.81		0.198	0.844*
		N	(%)	*n*	(%)	*n*	(%)	X^2	*p*
Sex	Woman	13	71.4	10	52.63	23	59	0.616	0.433*
	Man	7	28.6	9	47.37	16	41		
Primary CRF cause	Diabetes mellitus	7	35	11	57.9	18	46.2	5.749	0.124*
	Hypertension	12	60	5	26.3	17	43.6		
	Renal	1	5	1	5.3	2	5.1		
	Other	0	0	2	10.5	2	5.1		
Comorbidity	Diabetes mellitus	3	15	2	10.5	5	12.8	1.304	0.728*
	Cardiovascular disease	5	25	3	15.8	8	20.5		
	Other	3	15	2	10.5	5	12.8		
	None	9	45	12	63.2	21	53.8		

Note: *n*: number, AE: Aerobic exercise group, CSE: core stabilization exercise group, CRF: chronic renal failure, X: mean, SD: Standard deviation, X^2: chi-square analysis, *: $p > 0.05$.

Table 3. Comparison of pretest and posttest values for 5TSST, 2MST, PFS and KDQOL-36 measurement data in the groups.

			AE ($n=20$) X ± SD	CSE ($n=19$) X ± SD	Time F/p	Group*Time F/p	η_p^2
5TSST		Pre	19.77 ± 6.49	16.18 ± 5.12	20.377/<0.001**	0.012/0.915	0.000
		Post	16.87 ± 6.38	13.42 ± 3.36			
2MST		Pre	63.80 ± 18.29	76.53 ± 22.53	12.005/0.001*	0.379/0.542	0.010
		Post	73.45 ± 18.94	83.26 ± 22.46			
PFS	Behavior/severity	Pre	5.98 ± 1.27	6.15 ± 1.15	9.879/0.003*	0.112/0.739	0.003
		Post	5.47 ± 1.35	5.51 ± 1.41			
	Affective	Pre	5.94 ± 1.51	6.36 ± 1.40	6.782/0.013*	2.382/0.131	0.060
		Post	5.80 ± 1.21	5.81 ± 1.48			
	Sensory	Pre	6.07 ± 1.56	6.46 ± 1.48	26.030/<0.001**	0.005/0.943	0.000
		Post	5.19 ± 1.42	5.56 ± 1.41			
	Cognitive/mood	Pre	4.67 ± 1.83	5.68 ± 1.38	2.538/0.120	1.921/0.174	0.049
		Post	4.63 ± 1.51	5.22 ± 1.54			
	Total score	Pre	5.62 ± 1.36	6.14 ± 1.19	13.387/0.001*	0.998/0.324	0.026
		Post	5.25 ± 1.21	5.50 ± 1.36			
KDQOL-36	Symptoms/problems list	Pre	73.54 ± 13.26	80.04 ± 11.07	0.116/0.735	0.031/0.860	0.001
		Post	72.50 ± 11.10	79.71 ± 9.13			
	Effects of kidney disease	Pre	58.44 ± 15.28	71.55 ± 13.42	13.901/0.001*	1.231/0.274	0.032
		Post	69.38 ± 11.98	77.47 ± 10.80			
	Burden of kidney disease	Pre	25.63 ± 13.74	22.37 ± 12.73	59.982/<0.001**	9.680/0.004*	0.207
		Post	35.31 ± 16.76	45.07 ± 11.70			
	Physical health composite	Pre	30.09 ± 8.19	31.56 ± 5.47	3.192/0.082	0.004/0.949	0.000
		Post	32.21 ± 5.14	33.54 ± 7.15			
	Mental health composite	Pre	45.90 ± 8.10	43.14 ± 7.44	16.055/<0.001**	2.774/0.104	0.070
		Post	49.30 ± 7.87	51.35 ± 51.92			

Note: 5TSST: Five times sit to stand test, 2MST: 2-min step test, PFS: Piper Fatigue Scale, KDQOL-36: Kidney Disease Quality of Life-36, AE: aerobic exercise group, CSE: core stabilization exercise group, pre: before treatment, post: after treatment, X: mean, SD: standard deviation, p[a]: Paired t-test, p: repeated measures two-way analysis of variance, η_p^2: effect size, *: $p < 0.05$, **: $p < 0.001$.

composite among KDQOL-36 subparameters were found to have statistically significant increases ($p < 0.05$). When the changes over time are compared in the groups, apart from burden of kidney disease, variations were not observed to be statistically significant ($p > 0.05$). Burden of kidney disease data in the CSE group were significantly increased compared to the AE group ($p < 0.05$) (Table 3).

The time and time-group comparisons for Kt/V and URR values for dialysis adequacy in the AE and CSE groups are given in Table 4. When the variation over time for measurement data is compared within the groups, the variations were not observed to be statistically significant ($p > 0.05$) (Table 4).

Discussion

In this study, core stabilization and aerobic exercises were effective in increasing physical performance and quality of life and reducing fatigue; however, there was no difference in dialysis adequacy parameters. When the amount of development obtained in both treatment groups are compared, only the improvement in burden of kidney disease, one of the KDQOL-36 subparameters, was significantly increased in the CSE group compared to the AE group. The other variations between the groups were similar.

Hemodialysis patients are faced with heavy symptom burden and immobility, which causes low physical performance and reduced quality of life [1]. Though reduced physical function and physical immobility are associated with negative outcomes including mortality and hospitalization, they are potentially modifiable conditions [38]. In any case, boosting physical performance in patients with ESRD is crucial, as sedentary behaviors are associated with mortality [39]. Two comprehensive meta-analyses showed that physical exercise interventions improved physical performance including muscle strength and aerobic capacity in HD patients [40,41]. Abdelaal et al. investigated the effect of aerobic and resistance exercises for HD patients on physical performance and functional balance in a randomized controlled study using the

Table 4. Comparison of Kt/V and URR measurement data for dialysis adequacy of the groups.

		AE ($n=20$)	CSE ($n=19$)	Time	Group*time	
Variable		X ± SD	X ± SD	*F/p*	*F/p*	η_p^2
Kt/V	Pretest	1.34 ± 0.27	1.44 ± 0.27	1.391/0.255	0.402/0.670	0.011
	1 month later	1.38 ± 0.24	1.42 ± 0.27			
	Posttest	1.50 ± 0.57	1.49 ± 0.30			
URR	Pretest	66.37 ± 1.50	69.01 ± 1.54	0.695/0.502	0.556/0.576	0.015
	1 month later	68.98 ± 1.84	68.65 ± 1.89			
	Posttest	68.91 ± 1.59	69.76 ± 1.63			

Note: AE: aerobic exercise group, CSE: core stabilization group, URR: urea reduction ratio, *X*: mean, SD: standard deviation, *p*: repeated measures two-way analysis of variance, • ^2_p: effect size, *: $p<0.05$.

6 min walking test (6MWT) and Berg Balance Scale (BBS). In the study, both exercise trainings had positive impacts and aerobic exercise was identified to be more effective for the 6MWT and BBS tests compared to resistance exercises [42]. A thesis study by Çolak investigated the effect on physical performance of 10-week dynamic lumbar stabilization exercises and respiratory muscle training in HD patients. In this study, the 6MWT, timed up and go test (TUG) and 5TSST were used to assess physical performance. As a result of the study, HD patients receiving dynamic lumbar stabilization exercises and respiratory muscle training were observed to complete the physical performance tests in shorter duration [36]. The physical performance tests used in our research are time-limited applications that indicate comorbid diseases, survival rate, walking capacity, balance loss and fall risk [43,44]. The final assessments in the exercise groups observed the 5TSST test was completed in a shorter duration and the number of steps in the 2MST increased compared to the initial assessment. While good responses were obtained for physical components from our implemented exercise programs, the variation was not identified to be significant between the groups.

More than 90% of HD patients report feeling a lack of energy and physical fatigue is one of the most frequently experienced symptoms [45]. As a result, it is important to determine the fatigue levels of HD patients and then to ensure planning of special activities for patients [46]. Studies reported that training with intradialytic bicycle ergometry, EHA exercises and resistance exercises for the lower extremities had positive effects on fatigue [47–49]. Exercise is believed to expand muscle arteries, improve perfusion and alleviate disease affecting blood circulation in muscles [50]. As a result, it may provide improvements in perfusion, increased blood circulation, better toxin elimination, higher muscle strength and as a result lower fatigue levels in patients undergoing dialysis [47]. Low physical performance is associated with high fatigue rates with increasing energy expenditure [51]. In HD patients, we believe exercise reduces fatigue levels by increasing physical performance. Additionally, increased confidence with less anxiety and depression and better balance may reduce energy expenditure [52].

Quality of life may be lower in dialysis patients with low physical performance and fatigue symptoms compared to healthy individuals and this is generally associated with the impacts of factors like fatigue, diet and fluid restrictions and changes in body image [53]. Studies focused on exercise to increase quality of life of HD patients. However, systematic reviews and meta-analysis studies investigating the efficacy of exercise on quality of life in HD patients did not observe clear superiority for exercise [54,55]. Studies investigating the effect of intradialytic exercises on quality of life observed that some parameters of quality of life increased in patients who exercised; however, significant differences were not observed between the groups [56–58]. In our study, the burden of kidney disease subparameter of the KDQOL-36 scale improved in both groups, and this improvement was observed to be higher in the CSE group. Additionally, burden of kidney disease and mental health composite subparameters of KDQOL-36 improved similarly in both groups. Though this effect may be due to differences between study durations, type of exercise used in research, interest of the subjects, compliance and personal traits, generally intradialytic exercises may be said to increase quality of life of HD patients. This improvement in quality of life may not be due to the effect of exercise alone. Interventions targeting psychosocial and biological factors were identified to be important to improve quality of life of dialysis patients [59]. As a result, other positive effects of exercise in ESRD may have contributed to the increase in quality of life. Additionally, if the exercises were done based on virtual reality, they could provide more benefits by increasing the compliance and interest of their patients [60].

Exercise performed by dialysis patients was proven to be effective in improving the physical and mental quality of life of patients and from this perspective, exercise may be considered a complementary therapeutic intervention for dialysis adequacy. A potential strategy attracting attention in the last decade is intradialytic exercise [61]. In a systematic review and meta-analysis study published in 2023, for improving dialysis adequacy, intradialytic exercise proved to be more effective than non-intradialytic exercise [62]. An additional guess is that 60 min of intradialytic exercise may be considered equivalent to a traditional prescription to increase dialysis duration by 20–30 min in terms of soluble matter clearance [63]. However, Kirkman et al. identified that exercise did not replace increased HD duration for dialysis adequacy [64]. Several meta-analysis studies supported the view that intradialytic exercise improved dialysis adequacy [65,66]. However, there are studies stating that intradialytic exercise is ineffective for improving dialysis adequacy [36,67]. In our research, significant improvements were not found for both Kt/V and URR values of dialysis adequacy. This situation may have occurred due to the effect of daily well-being, not paying attention to nutrition, attending HD sessions with high weight increases requiring ultrafiltration of higher amounts of liquid or adopting poor behavior models.

Clinical implications

Intradialytic CSE and AE have been shown to have positive effects on physical performance, fatigue levels and quality of life in HD patients. It is recommended to include these exercises in the treatment of HD patients and to encourage them to exercise.

Limitations and future directions

The fact that the study was performed during HD dialysis and the need to keep the arm with the fistula in a fixed position may have made it difficult for the patients to maintain body integrity

during the exercises and may have reduced the focus on the exercises.

In our study, sarcopenia was assessed by SARC-F. Not using ultrasound imaging for sarcopenia control may be considered a limitation.

The study was performed in ESRD patients receiving treatment in one hemodialysis unit. Performing studies in different dialysis units may provide more comprehensive data. Additionally, in terms of evidence-based applications, we believe there is a need to perform more studies with increased treatment durations, investigating long-term efficacy, including more case numbers and a control group.

Conclusions

According to the results of our study, intradialytic core stabilization and aerobic exercises had similar positive impacts on physical performance, fatigue levels and quality of life and may be implemented for HD patients.

Our study is important as it is the first study to investigate the effects of core stabilization exercises during dialysis in HD patients. Strong aspects of the study include it being a randomized controlled study, valid and reliable outcome measures, the use of objective assessment methods for outcome measures and lack of any side effects due to implementation.

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