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The Effect of Aerobic Exercise on Physical Functional Performance among Hemodialysis Patients

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ABSTRACT

Background: Subjective reporting, peak oxygen consumption, physical performance, and muscular strength tests are used to evaluate the physical functioning of individuals with end-stage renal disease (ESRD). Hemodialysis (HD) patients usually require support to carry out their regular daily tasks. **Objective:** The aim of the current study was conducted to validate the effect of aerobic exercise on physical functional performance after HD.

Patients and methods: A total of 30 male patients, aged between 30 and 60 years old, undergoing HD for 3 months were recruited. These patients were divided randomly into two equal groups. Group A (Study group) included 15 patients undergoing HD would receive aerobic exercises in form of (treadmill device), in addition to their medical treatment**,** and Group B (Control group) included 15 patients undergoing HD would receive their medical treatment. Six Minutes' Walk Distance (6MWD) and Revised Piper Fatigue Scale (R-PFS) were compared between the 2 studied groups, together with the mean values of 6MWD and R-PFS in each group before and after the therapy.

Results: Test results showed that the study group's 6MWD statistically increased after treatment compared to before treatment, whereas the control group showed no such statistically significant improvement. After treatment, there was a significantly lower overall level of weariness in the study group compared to the control group (P=0.001). The mean overall weariness post-treatment for the study group was 2.58 (SD 0.81), while it was 5.8 (SD 0.37) for the control group.

Conclusion: Aerobic exercise was an effective method in enhancing physical functional performance in HD patients.

Keywords: Aerobic exercise, Physical functional performance, Hemodialysis.

INTRODUCTION

End-stage renal disease (ESRD) is a gradual irreversible malfunction of the kidneys that results in uremia by impairing the body's capacity to maintain fluid and electrolyte balance. Every year, there are 6% more individuals with end-stage renal illness. Patients with ESRD require renal replacement treatment in order to survive [1-2].

The major renal replacement therapy for ESRD is hemodialysis (HD), which is administered to around 91% of ESRD patients on a maintenance basis. Until the patient's death or until a successful kidney transplant is accomplished, HD is normally ordered to be conducted 3 times per week for 3-6 hours per session. Individuals with HD have lower levels of actual and self-reported physical function, and this is strongly associated with an increase in mortality [3].

The most frequent symptoms among these individuals are fatigue and muscle weakness. Loss of muscle mass (atrophy) and decreased protein storage in the body are two factors that can contribute to muscular weakness and have a major impact on mortality and hospitalization rates [4].

Workout regimens for these people have showed promise in terms of improving their physical functionality. Workout regimens have significantly increased aerobic capacity, decreased cardiovascular risk, and increased peak oxygen uptake [5].

The most often used physical function test in research on exercise in HD patients is the 6-minute walk test (6MWT) [6].

The effectiveness of exercise for dialysis patients may also differ depending on whether it is administered intradialytically or interdialytically [7].

Exercise that incorporates or enhances oxygen consumption in the body's metabolic or energy-generating processes is known as aerobic training, such as treadmill or stationary cycling. During the short-term intervention, an aerobic exercise programme enhanced the physical functional performance in HD patients. The 6MWT distance was greatly enhanced by the aerobic training programme. A regular aerobic exercise regimen can significantly enhance physical function. Functional ability has been demonstrated to improve with aerobic exercise [8].

Thus, this study was designed to provide a guideline about the effect of aerobic exercise in improving the physical functional performance after and to assist in planning an ideal treatment regimen for improving the physical function after HD.

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PATIENTS AND METHODS

A total of 30 male patients, aged between 30 and 60 years old, undergoing HD for 3 months were recruited. These patients were divided randomly into two equal groups. Group A (Study group) included 15 patients undergoing HD would receive aerobic exercises in form of (treadmill device), in addition to their medical treatment**,** and Group B (Control group) included 15 patients undergoing HD would receive their medical treatment.

Inclusion criteria were male patients with a range of age between 30 and 60 years. All patients underwent HD for 3 months. Prior to the study procedure, all patients underwent a nephrologist assessment. All patients had good compliance with their dialysis treatment (not missing more than 2 dialysis sessions in the prior 3 months). None of the research participants had a lower extremity dialysis graft, and they were all taking medication to maintain their health.

Exclusion criteria were patients with active inflammation or infection, patients with severe muscle weakness or skeletal deformity, diabetic foot, neuralgia, uncontrolled hypertension, repeated episodes of hypoglycemia, autoimmune disorders and body mass index (BMI) >35 kg/m^2.

MATERIALS

- 6-**Minute W**alk **T**est (**6MWT**): Patients with organ transplants are commonly evaluated for physical function using 6MWT.

- Revised Piper Fatigue Scale (**R-PFS**): An instrument designed to measure subjective fatigue, was developed, and psychometrically tested in samples of end-stage renal disease.

- Treadmill device.

Procedures:

Before taking part in the study, a permission form was signed by each male in both groups (A and B) and a thorough description of the methodology was given.

Therapeutic procedures:

Procedures of treadmill device:

During 8 weeks, participants conducted 3 30-minute aerobic exercise sessions each week. There were 3 parts to each workout session: warm-up, conditioning, and cool-down. We attached a blood pressure cuff and a heart rate monitor before each workout session and left them in place the whole time. During this time, doctors also evaluated the participant's clinical status (i.e., shortness of breath, cardiovascular symptoms, blood pressure, and heart rate). In order to ensure safety, the research assistant took the participant's blood pressure and pulse rate every 5 to 10 minutes during the session. If a participant's systolic blood pressure was >180 mmHg, diastolic blood pressure was >95 mmHg, or if their pulse was <60 beats per minute, they were disqualified from the exercise session. The warm-up period lasted for 5 minutes. The treadmill warm-up technique will involve slow running. The training portion will then come after the warm-up period. Beginning with 20 minutes of treadmill running at 60% of their maximum heart rate (MHR) in the first week, the training phase will gradually rise to 20 minutes of treadmill running at 75% MHR by the last week of training.

- Every patient was instructed to stand on the treadmill while it was turned off.
- Therapist was standing beside treadmill and said to the patient that the treadmill will be turned on.
- Patient was asked to put her hands on front rails to avoid falling.
- Therapist then started to turn on the treadmill and increased the speed gradually.
- Each session (30 minutes) was consisted of: a) 5 minutes low-speed treadmill walk for to warm up. b) 20 minutes of moderate walking (70% of MHR). c) 5 minutes cooling down by walking slowly on a treadmill as in warming up.

Ethical Approval:

This study was ethically approved by the Institutional Review Board of the Faculty of Medicine, Cairo University. Written informed consent was obtained from all participants. This study was executed according to the code of ethics of the World Medical Association (Declaration of Helsinki) for studies on humans.

Statistical Analysis

The collected data were introduced and statistically analyzed by utilizing the Statistical Package for Social Sciences (SPSS) version 25 for windows. Quantitative data were tested for normality by Kolmogorov-Smirnov test. Normal distribution of variables was described as mean and standard deviation (SD). Descriptive statistics and independent sample t-test were used to compare the average ages, 6MWD and R-PFS between the 2 studied groups. The 6MWD and R-PFS mean values in each group before and after the treatment were compared using a paired t-test. P value ≤0.05 was considered to be statistically significant.

RESULTS

6 MWD: The study group's mean 6MWD pretreatment was 289.66 meters, while the control group's was 284 meters. Pretreatment, there was no significant change in 6MWD between the study and control groups (**Table 1** and **Figure 1**).

Table (1): Comparison of pretreatment mean values of 6MWD between the study and control groups.

Variable	6MWD (meter) X̄ ± SD	Mean difference (MD)	t- value	P-value	Sig.
Study group	289.66 ± 44.66	5.66	0.34	0.73	NS
Control group	284 ± 45.79				

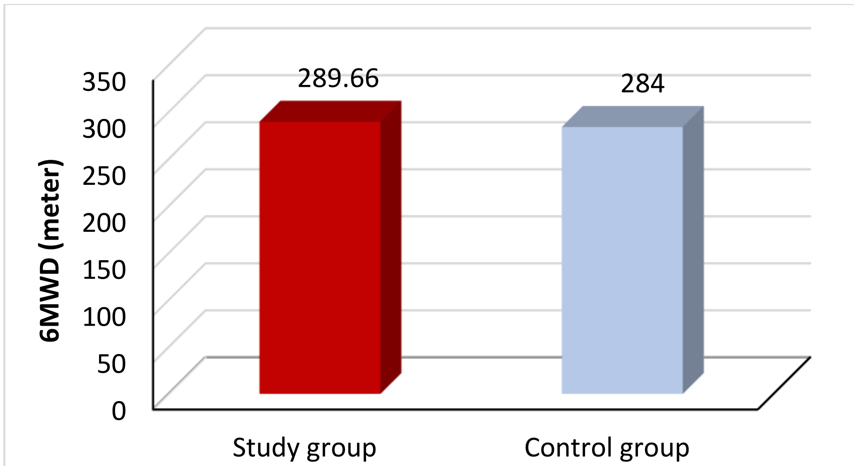

Figure (1): Pre-treatment mean values of 6MWD of the study and control groups.

The study group's mean 6MWD after treatment was 359.66 meters, while the control group's was 275.33 meters. The study group's 6MWD increased significantly more than the control group's after treatment (**Table 2** and **Figure 2**).

Table (2): Comparison of post treatment mean values of 6MWD between the study and control groups.

Variable	6MWD (meter) X̄ ± SD	MD	t- value	p-value	Sig.
Study group	359.66 ± 42.44	84.33	4.34	0.001	S
Control group	275.33 ± 61.97				

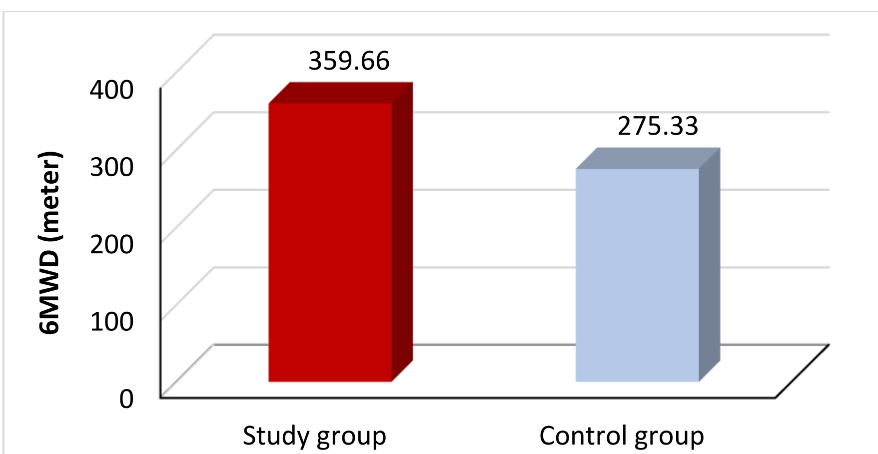

Figure (2): Post treatment mean values of 6MWD of the study and control groups.

R-PFS: The study group's mean total tiredness pretreatment was 5.96, while the control group's was 6.26. Pre-treatment, there was no significant difference in overall weariness between the study and control groups (**Table 3** and **Figure 3**).

Table (3): Comparison of pretreatment mean values of R-PFS between the study and control groups.

R-PFS	Study group	Control group	MD	t-value	P-value	Sig.
	$\overline{X}$ ±SD	$\overline{X}$ ±SD				
Behavior	6.13 ± 1.64	6.26 ± 1.53	-0.13	-0.23	0.82	NS
Affective	5.66 ± 1.54	6.4 ± 1.24	-0.74	-1.43	0.16	NS
Sensory	5.93 ± 1.03	6.2 ± 1.21	-0.27	-0.65	0.52	NS
Cognitive	6.13 ± 1.24	6.2 ± 1.47	-0.07	-0.13	0.89	NS
Total fatigue	5.96 ± 1.29	6.26 ± 1.3	-0.3	-0.63	0.53	NS

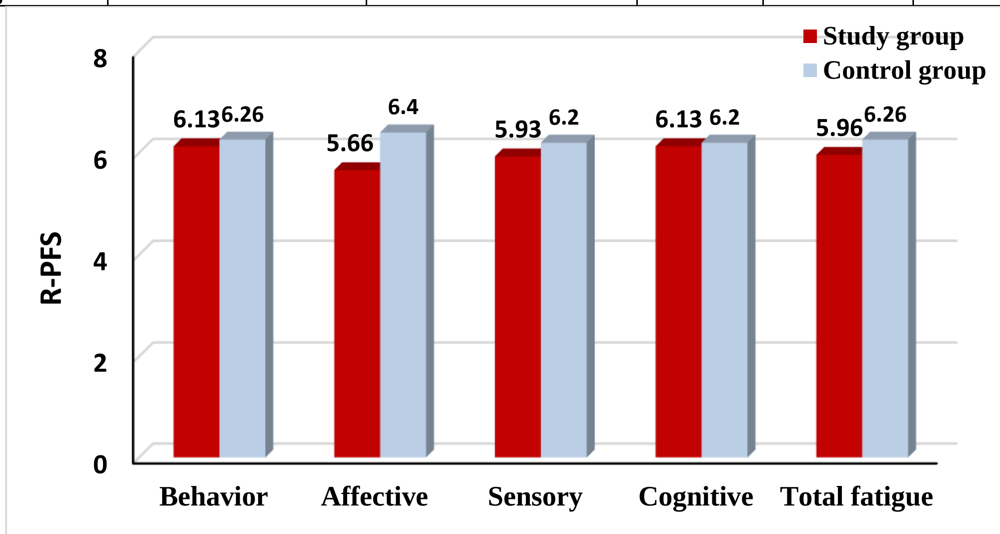

Figure (3): Pre-treatment mean values of R-PFS of the study and control groups.

The study group's mean overall tiredness after treatment was 2.58, while the control group's was 5.8. The overall weariness of the study group was significantly lower than that of the control group after treatment (**Table 4** and **Figure 4**).

Table (4): Comparison of post treatment mean values of R-PFS between the study and control groups.

R-PFS	Study group	Control group	MD	t-value	P-value	Sig.
	$\overline{X}$ ± SD	$\overline{X}$ ± SD				
Behavior	2.46 ± 1.24	5.73 ± 1.98	-3.27	-5.41	0.001	S
Affective	2.53 ± 1.06	5.87 ± 1.3	-3.34	-7.68	0.001	S
Sensory	2.47 ± 0.74	5.86 ± 1.45	-3.39	-8.04	0.001	S
Cognitive	2.87 ± 0.92	5.73 ± 1.38	-2.86	-6.68	0.001	S
Total fatigue	2.58 ± 0.81	5.8 ± 1.37	-3.22	-7.81	0.001	S

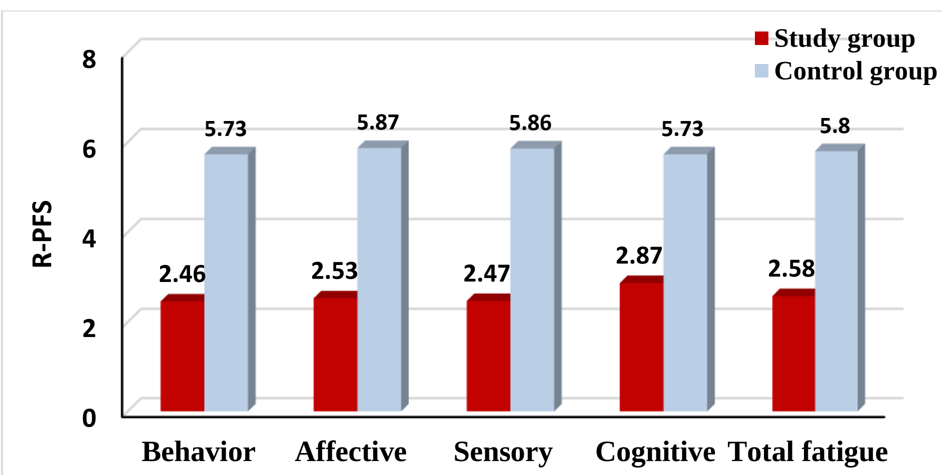

Figure (4): Post treatment mean values of R-PFS of the study and control groups.

DISCUSSION

We found in this study that during the short-term intervention, HD patients' physical functional performance was enhanced by an 8-week aerobic exercise programme.

In several exercise training programmes for the ESRD population, as a physical function outcome measure, the 6MWT has been utilized. Our findings are consistent with those of **Parsons *et al.* [9],** who discovered that treadmill exercise performed during HD for approximately 30 minutes per session at an intensity that caused patients to feel "slightly winded" increased the distance walked on the 6MWT by 14% in 15 HD patients who completed an 8-week exercise programme. Nevertheless, other trials that employed additional dialysis regimens showed a smaller decrease in 6MWT performance in HD individuals, if any change at all.

Due to two factors, the 24% improvement in 6MWT performance is most certainly not the result of a learning effect. First, repeat assessments taken on the same day are where learning effects with the 6MWT have been most clearly demonstrated. Each participant in the current study only underwent the test once, at baseline, and once at 8 weeks. It is extremely rare that a learning effect lasts for 8 weeks, and no information about repeatability longer than 4 weeks has been reported. Nevertheless, it is anticipated that this effect disappears after a few weeks.

Exercise's inability to improve these biochemical indicators can be attributed to a number of other variables, such as dietary condition, uncontrolled secondary hyperparathyroidism, dialysis membrane bioincompatibility, and medication use [10].

The results of this study corroborated those of a systematic review by **Hargrove *et al.*** [11] on the benefits of aerobic exercise for adults receiving maintenance hemodialysis for a range of hemodialysis-related symptoms, including fatigue, restless legs syndrome, depressive symptoms, and muscle cramping. Validated outcome measures with proven reliability and responsiveness in a wider range of hemodialysis populations are required to accurately capture the impact of this intervention.

The results of this study were in agreement with those of **Liu *et al.* [12],** whose main goals were to assess depression using the Beck Depression Inventory II [13] and physical functioning using the 6-min walk test and sit-to-stand test. The secondary outcome measurements included hematocrit, albumin, and triglyceride levels. Depression and physical functional performance differed significantly between groups, while albumin, hemoglobin, and cholesterol levels did not. According to research, exercise may be essential for maintaining physical functionality and reducing depressive symptoms. In HD facilities, exercise should be promoted and done while HD is occurring [13].

The 6-minute walk test (6MWT) was used to evaluate patients' functional performance before and after the intervention, and the results were in line with those of **Orcy *et al.*** [14]. In our sample of hemodialysis patients, aerobic and strength training jointly increased functional performance more than resistance training alone, despite the fact that the best exercise programme for dialysis patients is yet unclear.

The findings of this study were consistent with those of **Mohseni *et al.* [15],** who evaluated physical functional performance following HD and came to the conclusion that a low-intensity intradialytic exercise programme is an effective adjunctive therapy that enhances physical function and HD efficacy in HD patients.

Although though exercise has several proven health advantages, HD patients only sometimes or grudgingly exercise on days when they don't have dialysis. To increase adherence to an exercise programme, an organized setting and thorough patient monitoring are essential. Hence, HD is the best time to arrange an exercise intervention since there is a higher compliance rate and a better capacity to manage risk [16].

Recently, Kidney Disease International advised specialists and allied health professionals to include fitness training in their clinical services for persons with chronic renal illness. A long-term randomized, controlled exercise training trial that looks at the main mortality outcomes, such as cardio-vascular mortality, hospitalization, and cost-effectiveness in dialysis or, ideally, pre-dialysis patients, may be of the most interest [17].

CONCLUSION

The results of the present study demonstrated that a pragmatically designed, intradialytic aerobic exercise programme can significantly enhance physical function and psychological well-being for a variety of HD patients. As a result, exercise programmes should be created in HD facilities and HD patients should be encouraged to exercise while receiving HD therapy.

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