Zagazig University Medical Journal
www.zumj.journals.ekb.eg

https://doi.org/10.21608/zumj.2022.155561.2618 Volume 30, Issue 2, March 2024

Manuscript ID ZUMJ-2208-2618 (R1)
DOI 10.21608/ZUMJ.2022.155561.2618

ORIGINAL ARTICLE

Effect of Different Exercise Modalities on Physical Performance, Depression, Cognitive Function and Efficiency of Dialysis in Hemodialysis Patients

Nafesa M. Kamal[1*], Nillie EzzEldin[2], Ibrahim M. Salem [1], Amira Mohamed Yousef[3], Amany Elshabrawy Mohamed[3], Sahar Mahfouz[2]

[1]Internal Medicine Department, Faculty of Medicine, Zagazig University, Zagazig, Egypt,
[2]Rheumatologically and rehabilitation Diseases Department, Faculty of Medicine, Zagazig University, Zagazig, Egypt
[3]Psychiatry Departments, Faculty of Medicine, Zagazig University, Zagazig, Egypt

***Corrosponding auther:**
Nafesa M. Kamal
Internal Medicine Department, Faculty of Medicine, Zagazig University, Zagazig, Egypt

Email:
nanaashraf 8979@gmail.com

Submit Date 2022-08-23
Revise Date 2022-09-13
Accept Date 2022-09-20

ABSTRACT

Background: End-stage kidney disease (ESKD) may predispose the patients to greater a burden cerebral atrophy and white matter complexity. We evaluate the clinical and laboratory effects of different exercise types on the physical, mental performance and the efficiency of the dialysis process in hemodialysis patients.

Methods: Interventional cohort study was carried out on 62 patients with (ESKD) maintained on hemodialysis divided into group I; 20 treated with low intensity aerobic exercise, Group II; 20 treated with low intensity anaerobic exercise and Group III**:** 22 treated with combined exercise intradialytic and dialysis day of for 40-50 min during the first hour of dialysis session and the exercise program were done by our rehabilitation team. All were evaluated for physical performance & mental functions, before and after completion of the program.

Results: Combined exercise have a highly significant improving effect on modified mini-mental state exam (cognition)(P=0.0001) and a significant improvement on Addenbrooke's Cognitive Examination Revised (P<0.05) and executive function, (P<0.02), Beck's Depression Inventory-II (depressive symptoms) (P<0.0004), physical performance (P<0.0001), and dialysis efficiency ((P=0.016). Anaerobic exercise has a significantly improving effect on dialysis efficiency (P<0.0002) while aerobic exercise has significantly improved effect on depressive symptoms (P<0.0001).

Conclusions: Combined exercise significantly improved cognition and executive functions and physical performance. Dialysis efficacy is highly significant in the group under anaerobic exercise.

Key words: Exercise; Physical performance; Depression inventory; Cognitive function; Hemodialysis.

INTRODUCTION

With a growing prevalence of obesity, hypertension, and diabetes, it is estimated that there will be >1 million end-stage renal disease (ESRD) patients by 2025[1]. Cerebral atrophy and cardiovascular diseases and whit matter disease have high incidence in HD [2]. In dialysis patients, there is increased risk of arterial stiffness, cerebrovascular disease, stroke, all have bad impact on impairment of physical activity and cognitive ability, also they suffer from decreased aerobic capacity, reduced participation in physical activity, increased risk of falls, and decreased quality of life [3]. Studies have shown that a 15-25% increased risk of cognitive deficit for every 10 ml/min per 1.73 m2 reduction in estimated glomerular filtration rate (GFR) [4]. Exercise proved to have significant improving effect in power of back muscle, back and elbow flexibility, vertical jump and significant enhancement on Beck Depression Inventory in hemodialysis patients.[5]. The Clinical Practice Guidelines for Cardiovascular Disease in Dialysis Patients emphasizes that dialysis

staff should make effort to increase the level of exercise for all patients. [6]. The aim of the work was to evaluate the effect of different types of exercise on physical performance, mental function (depression & cognition) and efficacy of the dialysis process in ESRD patients maintained on HD.

METHODS

Study design, setting and duration:

In the Hemodialysis Unit of Zagazig university hospitals we carried out an interventional cohort study on maintenance hemodialysis patients within 3 months' duration. The study was approved by the local ethical committee of Zagazig university (ZUIRP#9004) and all patients were given an informed written consent to be enrolled in our study, after a complete explanation of the nature & benefits and work procedure of the research.

Patients' selection*:*

According to IRP sample size, Sixty-two patients with ESRD maintained on HD were included in this study, we involve sample size number only not all the unit HD patients, also HD unit not involve pediatric patients or else . According to inclusion and exclusion criteria we select our ***Patients:***

Inclusion criteria: Early- and middle-aged adults between 18 to 50 years old were included in the study. Bicarbonate solution with a polysulfide dialyzer (Fresenius, Bad Homburg, Germany) was used for hemodialysis treatments, three sessions (4 hrs. for each) per week, for 6 months with good arteriovenous fistula (AV) fistula. Before study by 2months all dialysis patients have stable for dry weight and had been attained free state of normotensive edema and more than 1.2 kt/v. Participants and medical staff responsible for the supervision of patients during the program were randomly selected for each group. Exclusion criteria include: patients aged < 18 or >50 years, refusing to enter the study, have any associated rheumatological diseases, pregnancy, neurological diseases, history of psychiatric disorders or previous trauma prevent doing exercise, heart failure grade 4(according to NYHA classification), history of angina in the previous 3months, high blood pressure >180/90 symptomatic peripheral vascular disease or limb ischemia, severe anemia (hemoglobin (Hb). below 7gm), low platelet (below 50), unstable patients before or during the exercise, subjects not adherent to the program, clotting of dialysis filter were excluded from the study.

Four patients were excluded from this study, one transferred to another HD center, one undergone renal transplantation (RT) and the other two refused to complete the program.

No side effect were observed all through the program as the patients closely observed by rehabilitation team and we selected middle aged patients to avoid other comorbidities that may affect physical fitness and may interfere with exercise program as we mentioned in our exclusion criteria . Transportation of the patients in day off was the main problem that forces us to stop after 3months.

Methods

Patients were randomly divided into three groups according to the type of exercise applied into group I: Including 20 HD patients on low-intensity aerobic exercise intradialytic, (4 males and 16 females), group II: Including 20 HD patients on low-intensity anaerobic exercise intradialytic (15 males and 5 females) and group III: Including 22 HD patients on low intensity aerobic and anaerobic exercise intradialytic and dialysis off day (12 males and 10 females).

Patients' safety

The data and safety monitoring board (DSMB) will review interim safety and efficacy data, the side effects that will happen as cramping, hypotension, hypertension, tachycardia, or headache. During every session, participants were supervised by a medical staff.

All patients that enrolled in our study were subjected to the following: Thorough history taking, complete physical examination and laboratory investigation, such as complete blood count, serum Sodium (Na), potassium (K), Calcium (Ca) Phosphorus (Ph), intact-parathormon hormone (I-PTH), liver and kidney function before and after the program. Cognitive and executive function assessment, depression assessment, dialysis efficacy (kt/v) and physical performance assessment were done for all patients before starting the program and after completing 3-month duration of exercises.

Physical performance was assessed by: (STs30 & 6-mWT and TUGT)

- (STs*30):* The sit to stand test (STS30) measures functional lower extremity strength during 30 s [7].
- (6-mWT): According to the American Thoracic Society The 6 min walking test measures roughly maximal exercise capacity [8].
- (TUGT): The measurement of basic mobility skills by timed up and go test [9]

The exercise program was composed of:

A-Low intensity aerobic exercise program:

1- Warm-up period: it is a 5-10 minutes of body exercises such as, static stretching (triceps,

hamstring, external rotator, quadriceps and adductors)

2- Aerobic exercise period: The applied aerobic exercises training includes: Range of motion exercises: rotation as follows: clockwise 20 rotations per minute (RPM), anti-clockwise 20 RPM, full extension and flexion of the wrist joint 20 times, full extension and flexion of the elbow joint 20 times, ankle joint will be rotating 20 RPM clockwise and 20 anticlockwise RPM then full extension and flexion of the knee joint 20 time counterclockwise, 20 times full flexion and extension of the knees and ankles.

3- Cool down period: It is necessary following the exercise period, 5-8minutes of total body exercise as warm up period, the patient was in a supine or seated position.

B-Low intensity anaerobic exercise program: Resistance training were applied through elastic resistance bands Eight muscle groups were trained with two sets of 1 min each with a 1 min break.

C-Low intensity combined aerobic and anaerobic exercise program: Starting with warm up period then low intensity aerobic exercise followed by the cool down period, occurred on day off, but intradialytic patients do low intensity anaerobic exercise.

Depressive symptoms of the patients were assessed by the Arabic Version of Beck's Depression Inventory – II (BDI-II): It measures the self-reported depression severity along previous two weeks represented in twenty-one inventory items and tack 10 min to completed, it was prepared by Ghareeb et al. [10] who said, in Arabic countries BDI-II have accepted reliability and validity, from 0.82 to 0.93 this is their range in these countries. Cognitive function was measured by Modified Mini-Mental State Exam (3MS) or MMSE which is the most commonly used cognitive screening test worldwide. Teng and Chui were developing an expanded version of MMSE by increasing number, difficulty and content of the assessment items [11]. The Addenbrooke's Cognitive Examination Revised (ACE-R) detects early cognitive impairment in dialysis patients with a good accuracy, the optimal cut-off value for ACE-R was <72 points [sensitivity 90%; specificity 85%; Kappa concordance (K) 0.79]. Psychomotor speed was measured by the time it took to complete the Trail Making Test Part A (TMTA) and time took to complete the Trail Making Test Part B (TMTB), and executive function was measured by (TMTB-TMTA). TMT used to evaluate target switch and visual attention, and consisted of 2 parts in which the patient asked to connect 25 dots as harry as he can accurately. This can inform us by a data about scanning, visual search speed, mental flexibility and speed of processing as well as executive functioning [12].

All these psychometric assessments were measured before the start of exercise program and 3-months later after doing the program.

STATISTICAL ANALYSIS:

Data management: Revised and verified data were edited on P.C, then statistical analyzed using windows version 20 & SPSS statistical package for the social science.

Frequency and percentage were used for characterization of Qualitative variables. (Mean ± SD) were used for depiction of quantitative variables. Comparison of qualitative variables was utilized by Chi-square (x2) test. Student t-test Mann Whitney was applied to compare quantitative variables. One-way ANOVA F- test represent more than two quantitative groups comparison will categorical data were descripted by Kruskal-Wallis test.

RESULTS

There was statistical significant difference between group III and the other two groups of patients regarding number of smoking patients, while there were no statistically significant differences between groups as regards the other parameters, table (1).

As regards to changes in the laboratory investigations after the 3-month interval of exercise program, we found a highly statistically significant decrease in Blood urea ($P<0.001$), S. Sodium ($P<0.05$), S. potassium ($P<0.05$) and Phosphorus ($P<0.01$) in the group of combined exercises as compared with the other two groups. There was a significant increase in Ionized CA, I-PTH, Hb and Albumin ($P<0.001$), in the combined exercises group. Although, there was an increased serum creatinine, CRP and platelets count in the combined exercise group, tables (2, 3).

As shown in tables (4, 5), there were statistically significant differences between the studied groups in percentage of change in cognition, executive function, physical performance, and dialysis efficacy. Regarding executive function, the anaerobic exercise group had the least percentage of decrease in (TMTB-TMTA). On the other hand, combined (aerobic & anaerobic) group had the highest decrease in TMTA&TMTB and (TMTB-TMTA). The percentage of increase in 3M score was highest in the combined (aerobic & anaerobic) group followed by the anaerobic group. The percentage of increase in ACE-R items was highest in the combined (aerobic & anaerobic) group except for fluency. Aerobic group had the highest increase in fluency compared to other groups. Regarding the

physical performance, combined (aerobic & anaerobic) group had the highest increase in STs30 and 6-mWT and the highest decrease in TUGT. Percentage of increase in dialysis efficiency was highest in aerobic and combined groups followed by anaerobic group. The percentage of decrease in BMI was highest in combined (aerobic & anaerobic) group followed by the anaerobic group. There were no statistically significant differences between the studied groups in parentage of change in depression scale, but as we have seen, the aerobic exercise group had the highest percentage of decrease in BDI-II near to combined group, On the other hand, the anaerobic group had the least decrease in BDI-II.

Table 1: baseline demographic data of all studied population and differences among groups.

Demographic data	Aerobic exercise group N=20	Anaerobic exercise group N=20	Aerobic & anaerobic exercise group N=22	Test	P-value (Sig.)
Male	4 (20%)	15 (75%)	10 (45.45%)	2.461 [C]	0.292 (NS)
Female	16 (80%)	5 (25%)	12 (54.54%)		
Age	38 ± 11.56	35 ± 12.53	40 ± 9.89	1.027	0.364 (NS)
HD duration	48 ± 17	45 ± 36	50± 21	*0.198*	0.821 (NS)
BMI (kg/m$^{2)}$	26.3 ± 5.02	26.1±4.6	25.5±7.8	0.101	0.905 (NS)
RF HTN	11 (55%)	10 (52.63%)	4 (16.66%)	0.366 [C]	0.833 (NS)
DM	8 (40%)	9 (47.36%)	6 (25%)	2.336 [C]	0.311 (NS)
DM &HTN	6 (30%)	7 (36.84%)	5 (28.33%)	0.780 [C]	0.644 (NS)
Smoking	4 (20%)	8 (42.10%)	0.0 (0.00%)	13.928 [C]	<0.001 (S)
EL Primary school	11 (55%)	8 (42.10%)	10 (41.66%)	4.94[c]	0.289 (NS)
High school	9 (45%)	5 (26.31%)	8 (33.33%)		
Academic	00 (00)	6 (31.57%)	6 (25%)		

([C]) Chi-square test p< 0.05 is significant EL: education level RF: risk factor BMI: body mass index HD: hemodialysis HTN: hypertension DM: diabetes mallets

Table 2: laboratory data of the studied groups before and after exercise program (EP).

Lab. Variable	Aerobic exercise N=20 Before exercise	Aerobic exercise N=20 After exercise	% 0f change	Anaerobic exercise N=20 Before exercise	Anaerobic exercise N=20 After exercise	% 0f change	Aerobic & anaerobic N= 22 Before exercise	Aerobic & anaerobic N=22 After exercise	% 0f change
Blood urea(mg/dl)	103±13.25	96±12.26	-6.79	112± 14.5	102± 13.6	-8.928	110 ± 6.5	89± 9.3	-19.09
S. Creatinine(mg/dl)	6.45 ± 0.48	7.46 0.45	13.53	7.5± 0.23	8.4 ± 0.32	12	6.9 ±0.72	8.1± 0.63	17.39
CRP	8.4±3.2	7.3 ±2.2	-13.09	10.6± 4.1	9.2± 2.1	-13.20	11.1 ± 3.7	9.3 ± 3.8	-16.216
S. Sodium (meq/L)	137 ±2.75	136 ± 2.15	-0.729	135 ±3.25	134 ± 2.1	-0.740	135.5 ±3.5	135 ± 3.6	-0.369
S.potassium (meql/L)	4.2± 0.35	4.1 ± 0.44	-2.38	4.1 ±0.3	3.9 ± 0.23	-4.878	4.4 ± 0.5	4.2± 0.4	-4.545
Ionized CA(mmol/L)	4.85± 0.47	4.77± 0.56	-1.649	4.86 ±0.71	4.84± 0.61	-0.411	4.5 ± 0.11	4.6 ± 0.10	2.222
Phosphorus(mmol/L)	4.1±0.30	4.0 ± 0.40	-2.439	4.6 ±0.4	4.5± 0.5	-2.173	5.5 ± 0.41	5.2± 0.30	-5.454
I-PTH (pg/mL)	102±8.75	100± 6.23	-1.960	127.6± 19.2	119 ± 17.6	-6.739	156.5 ±18.5	141± 16.9	-9.904
Hb (gm/dL)	10.9 ±1.1	11.1 ± 1.0	1.834	10.5± 0.50	10.9± 0.50	3.809	10.1± 1.2	11.2± 1.3	10.891
platelet (n/µL)	143.64± 13.9	143.3 ± 12.6	-0.208	152.76± 12	148.2±13.2	3.077	107.95±12 .8	121± 14.5	12.088
Albumin (mg/dl)	4.3±0. 46	4.4 ±45	2.325	4 .1± 0.4	4.0 ± 0.5	-2.439	3.6± 0.32	3.9 ± 0.18	8.333

Hb: hemoglobin. PTH: parathormone hormone TLC: total leukocytes count CRP: C- reactive protein S: serum I-PTH; intact- parathormone hormone

Table 3: comparison of percent of changes in laboratory data among studied groups.

Lab. Variable	Aerobic exercise. N=20 % 0f change	Anaerobic exercise. N=20 % 0f change	Aerobic. & anaerobic exercise. N=22 % 0f change	P-value (Sig.)
Blood urea(mg/dl)	-6.79	-8.928	-19.09	0.001
S. Creatinine(mg/dl)	13.53	12	17.39	>0.05
CRP	-13.09	-13.20	-16.216	>0.05
S. Sodium (meq/L)	-0.729	-0.740	-0.369	<0.05
S. potassium (meql/L)	-2.38	-4.878	-4.545	<0.05
Ionized CA(mmol/L)	-1.649	-0.411	2.222	<0.001
Phosphorus(mmol/L)	-2.439	-2.173	-5.454	<0.01
I-PTH (pg/mL)	-1.960	-6.739	-9.615	<0.001
Hb (gm/dL)	1.834	3.809	10.891	<0.001
platelet (n/µL)	-0.208	3.077	12.088	<0.001
Albumin (mg/dl)	2.325	-2.439	8.333	<0.001

Table 4: Cognition, BDI, physical performance and dialysis efficacy data comparison among the three studied groups before and after exercise program (EP).

Variable	variable data	Aerobic exer. N=20 Before EP	after ER	P-value (Sig.)	Anaerobic exer. N=20 Before EP	after EP	P-value (Sig.)	Aer. & anaerob. N=22 Before EP	after EP	P-value (Sig.)
executive Function	TMTA	47.0±3.4	45.1±3.2	0.0001**	49.02±4.1	44.00±3.9	0.0003 **	46.01±6.5	39.5±6.2	0.0025(HS)
	TMTB	121.5±17.5	118.3±17.02	0.5612	117.00±16.1	112.8±15.2	0.4016	119.7±16.6	106.9±13.3	0.0050(HS)
	TMTB-TMTA	74.4±12.4	73.2±11.2	0.7498	68.03±10.7	59.8±11.1	0.0221 *	73.6±13.02	67.4±11.4	0.0263(S)
3MS	3M score	81.8±5.0	82.6±7.4	0.6910	84.01±4.2	89.3±3.3	0.0001 **	83.3±4.3	90.00±3.6	0.0001(HS)
ACE-R	Attention	15.6±2.1	16.01±1.7	0.501	14.2±2.3	15.7±2.1	0.0377 *	14.3±2.2	15.9±1.6	0.0147(S)
	memory	15.5±2.8	15.0±3.9	0.644	15.4±3.1	16.9±5.1	0.280	15.6±3.5	18.5±4.01	0.0051(HS)
	fluency	5.6±3.3	5.6±4.2	0.455	6.7±2.5	7.8±4.6	0.365	5.8±2.7	6.5±3.2	0.0024(HS)
	language	19.5±6.5	20.0±7.1	0.717	18.9±4.4	20.4±4.5	0.249	18.7±4.3	21±3.7	0.0530(S)
	Visuospatial	10.2±4.1	11±4.2	0.592	9.9±3.03	10.8±5.4	0.530	9.8±3.1	12.02±4.1	0.0546(S)
	Total	68.6±14.5	69.8±16.7	0.809	67.3±15.93	71.8±17.1	0.406	65.4±15.6	73.4±16.5	0.0911
BDI-II	Score	24.9±8.9	13.67±6.2	0.0001**	21.49±11.4	12.92±9.0	0.0144 *	26.09±7.5	15.23±11.6	0.0004(HS)
Physical performance	STs30	13.4±6.1	18.2±8.2	0.0424*	14.5±7.1	20.2±8.2	0.0279 *	16.3 ±5.5	29.1±11.7	0.0001(HS)
	6-mWT	249±87	291±86	0.133	252±67	322±65	0.0024 **	270±74	356±77	0.0003(HS)
	TUGT	12.3±3.8	10.5±3.1	0.1090	11.2±4.1	9.4±3.5	0.154	12.7±3.1	7.1±2.6	0.0001(HS)
Dialysis efficiency	Kt/v	1.32±0.32	1.56±0.51	0.0826	1.35±0.13	1.59±0.21	0.0002 **	1.43±0.44	1.7±0.30	0.0167(S)
BMI		26.3 ± 5.02	25.9±6.01	0.820	26.1±4.6	25.2±5.4	0.573	25.5±7.8	23.8±4.9	0.3706

TMTA: Trail Making Test Part A, TMTB: Trail Making Test Part B, Kt/V: standardized dialysis dose,*specific,**high specific, BDI-II: Beck's Depression Inventory – II, BMI: body mass index 3MS: Modified Mini-Mental State ,ACE-R: Addenbrooke's Cognitive Examination Revised, TUGT. The timed up and go test is a short test, STs30. The sit to stand test (STS60), 6-mWT**.** The 6 min walking test

Table 5: Percent of changes comparison in cognition, depression, executive function, physical performance and dialysis efficacy of the studied groups.

Variable	variable data	Aerobic exercise. N=20 % 0f change	Anaerobic exercise. N=20 % 0f change	Aerobic. & anaerobic. N=22 % 0f change	P-value (Sig.)
executive Function	TMTA	17.234	-10.20	-14.130	0.001 (HS)
	TMTB	-2.880	-3.589	-10.693	0.001 (HS)
	TMTB-TMTA	-14.650	-5.079	-8.423	0.001 (HS)
3MS	3M score	0.977	6.309	8.043	0.001 (HS)
ACE-R	Attention	2.564	10.56	11.188	0.001 (HS)
	memory	-3.225	9.740	18.589	0.001 (HS)
	fluency	17.85	16.417	12.068	0.001 (HS)
	language	2.564	7.936	12.299	0.001 (HS)
	Visuospatial	7.843	9.090	22.448	0.001 (HS)
	Total	1.306	6.686	12.232	0.001 (HS)
BDI-II	score	-44.979	-39.719	-41.538	0.114
Physical performance	STs30	43.283	39.310	78.527	0.001 (HS)
	6-mWT	16.867	27.777	31.581	0.001 (HS)
	TUGT	-14.634	-16.071	-44.094	0.001 (HS)
Dialysis efficiency	Kt/v	23.076	14.275	17.881	0.001 (HS)
BMI		-1.520	-3.448	-6.666	0.001 (HS)

DISCUSSION

Hemodialysis is predominantly the only long-term treatment option for ESKD patients [1]. The high burden of increased risk of depression, decrease quality of life and cognitive impairment in ESKD, push the medical staff to encourage non-pharmacologic training strategies that impact its benefit on mental function in such a way that translates to improvements in activities of daily living and long- term outcomes such as dementia progression and survival. Exercise training (ET) enhances synaptic connections between brain cells and improves brain plasticity [13].

Our study found that, combined (aerobic & anaerobic) exercise has high significant effect on cognition and executive function better than in anaerobic and aerobic groups. This is in concordance with Mc Adam et al. [14] who stated Cognitive and executive function was preserved in exercise training patients more than in cognitive training one, and Chu et al. [15] who measured cognitive and executive function using the 3MS, TMTA, and TMTB which be improved in exercised patient While those randomized to the non-exercise training arm experienced decline in psychomotor speed and executive function at 3-months. Exercise training improves executive function [16] through increased: 1) cerebral blood flow [17] 2) brain volume in the prefrontal cortex and hippocampus. [18] 3) brain-derived neurotrophic factor. [19] 4) engagement of neural structures and 5) modulation of several hormones (i.e. β-endorphin, cortisol), which may affect the morphology of brain structures associated with cognitive functions [20]. Also, exercise training reduces inflammatory markers, including C-reactive protein, tumor necrosis factor alpha, and IL-6, resulting in improved brain plasticity and executive function [21].

The best and highest statistically significant improvement on beck depression inventory (BDI) have to be occurred in combined exercise group and aerobic group, which is better than in anaerobic group, this was in harmony with the meta-analysis by Shimoda et al. [22] who observed muscular training faces to relieve depressive symptoms in dialysis patients.

Physical activity is associated with the release of monoamine neurotransmitters (serotonin, dopamine, and norepinephrine) that support for the use of aerobic exercise to reduce and manage depressive symptoms [23], despite antidepressant medications [24]. In

addition, it improves the neurological function, with increased levels of neurotropic factors in the brain and improvements in mood [25]. According to physical performance, it had highly significant advances in the combined group which was better than in the other two groups as same as Anding et al [26] which conducted a one-year follow-up of an endurance and combined resistance training and detected considerable ($p<0.05$) advance for exercise capacity (HA: 55%, MA: 45%) and strength (HA: >120%, MA: 40–50%) in both series. Three factors contribute to lower physical activity in hemodialysis patients mostly: (1) Diminished muscle strength due to muscle wasting and catabolism [27] (2) Increment of comorbid disorders and cardiovascular prevalence, both leads to reduced quality of life (QOL), [28, 29, 30] which associated with (3) reduced physical fitness. Dialysis efficiency (DE) was to be highly significant in the the combined-exercise group and anaerobic group while significant in aerobic group ($P<0.045$), in accordance with us Mohseni et al. [31] said, dialysis efficacy (DE) increased with simple aerobic exercise and considered it safe, effective and complementary HD modalities., also Heiwe et al. [32] declare that DE, arterial stiffness, blood pressure, high-sensitive C-reactive protein (HS-CRP), health-related quality of life (QOL) and depression have strong positive correlation with exercise.

As regards to changes in the laboratory investigations after the 3-months interval of exercise program, we found a highly statistically significant decrease in Blood urea ($P<0.001$), S. Sodium ($P<0.05$), S. potassium ($P<0.05$) and Phosphorus ($P<0.01$) in the group of combined exercises as compared with the other two groups. There was a significant increase in Ionized CA, I-PTH, Hb and Albumin ($P<0.001$), in the combined exercises group. Although, there was an increased serum creatinine, CRP and platelet count in the combined exercise group this increase did not reach the level of significance it is in concordance with Assawasaksaku et al. [33] who Followed 6-month of intradialytic cyclic exercise (IDX), and found that patients showed significantly increment of physical activity and there were significantly higher hemoglobin and albumin levels, with significant serum phosphate and potassium reduction.

Limitations of our study included a small sample size, single center study and being carried out on a specific age that did not allow for randomization of a control group.

CONCLUSIONS

Cognition and executive functions, dialysis efficiency and physical performance improved by combined (aerobic & anaerobic) exercise, while aerobic exercise have the best effect on depressive symptoms and executive function. Anaerobic exercise was found to be beneficial to cognition function, and dialysis efficiency (DE).

So, we recommend development of specific protocols for regular combined physical activity which can boosted as an alternative method to promote mental health and maintain of physical performance essential for the independence of HD.

Conflict of interest: Non

Financial disclosure: Non

REFERENCES

1. United States Renal Data System, 2016 Annual Data Report: Atlas of Chronic Kidney Disease and End-Stage Renal Disease in the United States. Bethesda: National Institute of Diabetes and Digestive and Kidney Diseases; 2016.

2. Drew DA, Bhadelia R, Tighiouart H, Novak V, Scott TM, Lou KV et al. Anatomic brain disease in hemodialysis patients: a cross-sectional study. Am J Kidney Dis. 2013; 61(2):271–8.

3. Kim ED, Meoni LA, Jaar BG, Shafi T, Kao WHL, Estrella MM et al. Association of arterial stiffness and central pressure with cognitive function in incident haemodialysis patients: The PACE Study. Kidney Int Rep. 2017; 2(6):1149–59.

4. Kurella Tamura M, Vittinghoff E, Hsu CY, Tam K, Seliger SL, Stephen Sozio S et al . Loss of executive function after dialysis initiation in adults with chronic kidney disease. Kidney Int. 2017; 91(4):948–53.C

5. Rhee SY, Song JK, Hong SC, Choi JW, Jeon HJ, Shin DH, et al. Intradialytic exercise improves physical function and reduces intradialytic hypotension and depression in hemodialysis patients. KJIM. 2017; Aug 25:020

6. K/DOQI Workgroup: K/DOQI clinical practice guidelines for cardiovascular disease in dialysis patients. Am J Kidney Dis, 2005, 45: S1–S153. [PubMed]

7. Steffen TM, Mollinger LA. Age- and gender-related test performance in community-dwelling adults. J Neurol Phys Ther 2005; 29:181–8.

8. Segura-Orti E, Martinez-Olmos FJ. Test-retest reliability and minimal detectable change scores for sit-to-stand-to-sit tests, the six-minute walk test, the one-leg heel-rise test, and handgrip strength in people undergoing hemodialysis. Phys Ther 2011; 91:1244–52.

9. Kono K, Nishida Y, Moriyama Y, Yabe H, Taoka M, Sato T. Investigation of factors affecting the six-minute walk test results in haemodialysis patients. Ther Apher Dial. 2014; 18: 623–7.

10. Ghareeb AG. Cairo, Egypt: Angle Press; 2000. Manual of the Arabic BDI-II. and psychometric properties were assessed in Arabic countries. (Alansari BM. Kuwait:The

New Book Home Co., Kuwait University; 2005. Beck Depression Inventory (BDI-II) Sourcebook of Personality disorders Scales.
11. Mioshi E, Dawson K, Mitchell J, Arnold R, Hodges JR. The Addenbrooke's Cognitive Examination Revised (ACE-R): a brief cognitive test battery for dementia screening. Int J Geriatr Psychiatry. 2006; 21: 1078–85.
12. Arnett JA.; Seth SL . "Effect of physical layout in performance of the Trail Making Test". Psychol. Assess.1995; 7 (2): 220–1.
13. Spatz HC. Hebb's concept of synaptic plasticity and neuronal cell assemblies. Behav Brain Res. 1996; 78(1):3–7.
14. McAdams-DeMarco MA., Chu N M, Stecke M, Kunwar S, Fernández M G. Interventions Made to Preserve Cognitive Function Trial (IMPCT) study protocol: a multi-dialysis center 2x2 factorial randomized controlled trial of intradialytic cognitive and exercise training to preserve cognitive function. BMC Nephrology (2020) 21:383
15. Chu NM, McAdams-DeMarco MA. Exercise and cognitive function in patients with end-stage kidney disease. Semin Dial. 2019; 32(4):283-90.
16. Erickson KI, Kramer AF. Aerobic exercise effects on cognitive and neural plasticity in older adults. Br J Sports Med. 2009; 43(1):22–4.
17. Stringuetta Belik F, Oliveira ESVR, Braga GP, Bazan R. Influence of intradialytic aerobic training in cerebral blood flow and cognitive function in patients with chronic kidney disease: a pilot randomized controlled trial. Nephron. 2018; 140(1):9–17.
18. Voss MW, Prakash RS, Erickson KI. Basak C, Chaddock L, Kim JS, et al. Plasticity of brain networks in a randomized intervention trial of exercise training in older adults. Front aging neurosci. 2010; 2:32.
19. Anderson-Hanley C, Arciero PJ, Brickman AM, Okuma N, Westen SC, Merz ME, et al. Exergaming and older adult cognition: a cluster randomized clinical trial. Am J Prev Med. 2012; 42(2):109–119.
20. Abdelrahman HM, Elawam AEE, Alghitany AN. Cognitive impairment among Egyptian older adults on hemodialysis. ME-JAA, 2014; 11(3):18-24.
21. Nascimento CM, Pereira JR, Pires de Andrade L, Garuffi M, Ayan C, Kerr DS, et al. Physical exercise improves peripheral BDNF levels and cognitive functions in mild cognitive impairment elderly with different bdnf Val66Met genotypes. J Alzheimer Dis. 2015; 43(1):81–91.
22. ShimodaT, Matsuzawa R, Hoshi K, Yoneki K, Harada M, Watanabe T, et al. Effects of supervised exercise on depressive symptoms in hemodialysis patients: a systematic review and meta-analysis of randomized controlled trials Ren. Replace. Ther 2017; 3: 56.
23. Peter T, John FS, Seals HP, Douglas R. Endorphins and exercise: physiological mechanisms and clinical implications. Med Sci Sports Exerc.1990; 22: 417–28.
24. Papakostas GI. Tolerability of modern antidepressants. J Clin Psychiatry. 2008; 69(Suppl E1):8–13.
25. Greenwood BN, Monik F. Exercise, stress resistance, and central serotonergic systems. Exerc Sport Sci Rev. 2011; 39:140–9.
26. Anding K, Bär T, Trojniak-Hennig J, Krause KR, Jan M, Rost JM, et al. A structured exercise programme during haemodialysis for patients with chronic kidney disease. clinical benefit and long-term adherence. BMJ Open. 2015;5: e008709.
27. Painter P. Physical functioning in end-stage renal disease patients: update 2005. Hemodial Int 2005; 9:218–35.
28. Johansen KL, Doyle J, Sakkas GK, Kent-Braun JA. Neural and metabolic mechanisms of excessive muscle fatigue in maintenance hemodialysis patients. Am J Physiol Regul Integr Comp Physiol 2005; 289: R805–13.
29. Finkelstein FO, Wuerth D, Finkelstein SH. Health related quality of life and the CKD patient: challenges for the nephrology community. Kidney Int 2009; 76:946–52.
30. Kimmel PL, Patel SS. Quality of life in patients with chronic kidney disease: focus on end-stage renal disease treated with hemodialysis. Semin Nephrol 2006; 26:68–79.
31. Mohseni R, Emami Zeydi A, Ilali E, Adib-Hajbaghery M, Makhlough A. The effect of intradialytic aerobic exercise on dialysis efficacy in hemodialysis patients: a randomized controlled trial. Oman Med J. 12013; 28(5):345-9.
32. Heiwe S, Jacobson SH. Exercise training in adults with CKD: a systematic review and meta-analysis. Am J Kidney Dis 2014; 64:383-93.
33. Assawasaksaku N, Sirichana W, Joosri W, Kulaputana O, Eksakulkla S, Ketanun C, et al. Effects of intradialytic cycling exercise on daily physical activity, physical fitness, body composition, and clinical parameters in high‐volume online hemodiafiltration patients: a pilot randomized‐controlled trial. Int Urol Nephrol. 2021; 53:359–71

To cite:

kamal, N., Ezzeldin, N., salem, I., Youssef, A., El-Shabrawy, A., Abdil Galil, S. Effect of Different Exercise Modalities on Physical Performance, Depression, Cognitive Function and Efficiency of Dialysis in Hemodialysis Patients. Zagazig University Medical Journal, 2024; (335-342): -. doi: 10.21608/zumj.2022.155561.2618