Resisted Exercise Versus Whole Body Vibration in Selective Renal Functions and quality of life in Hemodialysis Patients

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ABSTRACT

Background: *The disorder known as chronic kidney disease (CKD) is characterized by continuous changes in either the structure, function of the kidney, or both, with potential consequences to an individual's health.* ***Purpose of the Study:*** *This study was carried-out to examine the impact of resisted exercise against whole body vibration in selective renal functions and quality of life in hemodialysis patients.* ***Subjects and Methods:*** *The study included sixty patients, aged 40 to 50, who were selected from the hemodialysis center at Mashtoul Al-Souk Centeral hospital in Alsharkia, Egypt. The patients were of both sexes and suffered from chronic renal failure. They were randomized into three equally matched groups (A, B, and C). Group A was given resisted exercise using ankle free weights for lower limb muscles, 3times-weeks for 12 weeks, Group B was received Whole-body vibration training (WBVT) for 3times –week for 12 weeks and group (C) was received conventional physical therapy program (aerobic exercise and breathing exercises). The following tests were conducted twice: once prior to treatment and once after: creatinine, blood urea nitrogen, urea reduction ratio, 6-minute walk test, as well as the quality-of-life questionnaire.* ***Results:*** *The findings revealed that post-treatment, there was significant decrease of Urea, and URR as well as significant increase of energy, emotion, total of Sf 36 and 6MWT in group A & B when compared to control group. There was as significant decline of creatinine in group B when compared to control group and no significant difference of creatinine in group A when compared to control group. while there was no significant difference among group B and group A after treatment.* ***Conclusion:*** *Both resistive exercise and whole-body vibration have been shown to increase dialysis efficiency as well as performance.*

Key words*: chronic kidney disease, resisted exercise, whole body vibration*

INTRODUCTION

Over time, CKD has come to be defined as renal failure, as measured by a GFR of fewer than 60 mL/min per 1.73 m2 for a minimum of 3 months [1]

Today end-stage renal disease (ESRD) is still serious health problem. When nephrons deteriorate to an advanced level, kidney failure persists for an extended duration, a diagnosis of ESRD means dialysis or a transplant is necessary. A decline in clinical status due to ESRD is associated with alterations in the structure as well as function of the musculoskeletal system. The result is a sedentary lifestyle that progressively impairs the patient's independence. It was revealed that incident dialysis patients often suffer from low functional ability, tiredness weariness, and under nutrition. Muscular strength, cardio-pulmonary fitness, in addition to quality of life are all diminished in this group due to complications such uremia, anaemia, myopathy, and neuropathy [2].

Worldwide, chronic kidney disease affects over 50 million people, with over 1 million requiring dialysis or a kidney transplant.

Patients with severe CKD, particularly those on long-term dialysis, have muscle wasting and extreme tiredness, both of which contribute to a decrease in physical activity and overall quality of life. Increased death rates have been linked to this worsening in CKD [3]

The Kidney Disease Outcomes Quality Initiative of the National Kidney Foundation recommends a URR of more than 65%. For this reason, we predict that urea and toxins will move more freely from the tissue to the vascular compartment during intra dialytic exercise, it improves muscle flow as well as the quantity of open capillary surface area in the exercising muscle [4] (Amira et al.,2019(

In patients with ESRD, hemodialysis is a common type of renal replacement therapy, but it is a time-consuming operation that must be performed at least three to five times a week for at least three to five hours each session. Many researchers anticipate benefits from both dialysis and exercise when patients engage in intradialytic exercise, despite the fact that many questions remain unanswered concerning the efficacy of exercise during hemodialysis [5].

Patients undergoing hemodialysis (HD) have a far worse quality of life (QOL) than both healthy persons and those who have had a kidney transplant. Fatigue, which includes physical and mental depletion, lack of desire, and inactivity, is sometimes blamed for this phenomenon [6]

Dialysis patients' quality of life (QOL) may be improved with exercise, despite the fact that patients often have low exercise tolerance [7]

Low intrinsic motivation has been highlighted as a key hurdle to prescribing exercise to hemodialysis patients, who are much less active than healthy, sedentary adults.

Loss of muscle mass and mitochondrial dysfunction, similar to age-related sarcopenia, are hallmarks of chronic kidney disease. Exercise modalities that promote mitochondrial activity in ageing muscle and reverse sarcopenia include resistance and aerobic exercise training [4]

One preventative measure that may slow the breakdown of muscle tissue or preserve muscular function is regular exercise. The rate at which muscle proteins are synthesized is directly influenced by physical activity. To wit [8]

Patients on dialysis for ESRD report worse health-related quality of life (HRQOL). These people are prone to problems like depression, inflammation, and starvation. Both [11,12] support this idea.

Patients with ESRD may benefit from a higher quality of life and fewer problems if their therapy is of higher quality [11]

To improve exercise performance in people with hemodialysis, whole-body vibration training (WBVT) may provide a novel and time-efficient method. Standing on a vibrating platform that applies vibrations of varying frequencies is standard procedure for WBVT. The muscular relaxation period is cut short during high-frequency (20 Hz) training, leading to a greater force production [12]

Whole-body vibration is a style of physical exercise during which a person stands on a vibration platform that may induce acceleration mostly in the vertical (Fz) direction. The g-forces are felt as accelerations and are thought to produce the same physiological reactions as aerobic conditioning and resistance training [12]

MATERIALS AND METHODS

Study design: This randomized **2.1.: Subjects:**

Sixty patients from the hemodialysis unit of Mashtoul Al-Souk Centeral hospital in Alsharkia, Egypt, all with a diagnosis of chronic renal failure (CRF) grade 5, took part in the study. These people were divided into three groups with the same number.

- Group A got 12 weeks of thrice-weekly resistance training
- Group B got 12 weeks of whole-body vibration training (3 sessions each week)
- Group C got conventional physical therapy program (aerobic exercise and breathing exercises).

All patients were under contentious surveillance throughout physical therapy sessions.

Inclusive criteria:

Participants who met the following requirements were included in the study:

There are a total of 60 patients in the trial, about 40–50 years old, The research included patients of both sexes, Everyone who has advanced to stage 5 CRF, All patients were doing well on dialysis for a period of two months and All patients were being closely monitored by medical staff.

Exclusive criteria:

A patient was not eligible to participate in the trial if they:

Lower extremity prostheses, or treatment after a bone fracture; Just recently, Having a previous history of DVT , A preexisting aneurysm in an artery, Warning indications of a cardiac arrest (eg, congestive heart failure), High blood pressure in the arteries, Disabling mental illness or cognitive dysfunction, the nervous system, Diseases including cancer, autoimmune disorders, and infections that are currently active, patients affected by a metabolic condition (DM)

2.2.:Tools:

A-Evaluation tools:

-1Assessment of quality of life using (medical outcome study 36-SF36), Subscales of SF-36:

- Able to perform physically.
- Importance of physical health-related constraints.
- The inhibiting effect of an emotional issue.
- Vitality.
- The state of one's emotions.
- To operate socially.
- Pain
- Wellness in general.

The scoring instructions for the SF-36 are:

A total percentage score is calculated for every one of the eight domains assessed by the SF36. The possible percentage scores are from 0% to 100%. These are determined via a two-stage mathematical process. There is a numerical value associated with each answer choice in the survey. The raw scores are normalized to a scale from 0 to 100, where 0 represents the lowest potential QOL on that item while 100 represents the maximum potential QOL. Step two involves converting the ratings and calculating the mean across all eight dimensions. The findings were published in 2019 [13]

2- Laboratory investigation:

Creatinine, blood urea nitrogen, and the urea reduction ratio.

-3 Assessment of physical performance by 6WMT.

B) Treatment tools:

1- Sand bag (weight 3kg) for resisted exercise (group A)

2-Whole body vibration:(crazy fit exercise machine) (Group B)

Treatment procedure:

Group A:

Group B: Twenty participants all got Whole body vibration

A) Mode: standing exercise

- Intensity:40 Hz
- Amplitude: 1.5 mm
- Duration:10 min.
- Frequency: 3 sessions a week.
- Total duration: 12 weeks.

Group C: Control group

twenty patients who received conventional physical therapy program (aerobic exercise and breathing exercises).

Data collection and Statistical analysis:

- The mean as well as standard deviation of the participants were calculated using descriptive statistics. Age (in years), weight (in kilogrammes), height (in centimetres), and body mass index (in kilogrammes per square metre) were compared among the three groups using descriptive statistics and analysis of variance.
- Test of Chi squared was done for assessment of allocation of sex among groups, In advance of analysis, test of

Ankle weight exercise targeting knee extension and flexion for strength training. Within 12 weeks, you'll spend 20 minutes doing this three times a week.

The therapy plan included three phases:

- Mode: the muscles that bend and straighten the knee.
- Intensity: 70% of 1RM.
- Duration: 25 minutes per.
- Time of repetition: Three sets of eight to ten reps with 2 to 3 minutes of rest among sets.
- Frequency: Three times a week.
- durations: 12 weeks.
- Warming up phase: 5 mint exercise.
- Active phase: (15min) exercise.
- Cooling down face: (5min) exercise.

Shapiro-Wilk was applied to evaluate the data normality. Testing for homogeneity across groups using Leaven's homogeneity of variance yielded the expected result of normally distributed data with homogeneity of variance. No outliers were seen in the box plot.

- of life (as assessed by the SF-36 questionnaire), performance (as assessed by the 6-minute walk test), and renal function (as measured by the creatinine clearance rate) were each subjected to a repeated-measures analysis of variance (MANOVA) with a mixed 3 x 2 design to determine the effects of treatment (between groups) (URR, blood urea nitrogen and creatinine).
- All statistical tests were performed with a significance level of p 0.05.
- The statistical program for the social sciences (SPSS) IBM SPSS for Windows (Chicago, Illinois, USA) 20th version was utilized to conduct all statistical tests.

Results

Data collection and Statistical analysis:

Descriptive statistics was utilized to determine mean and SD of the Participants. Descriptive statistics and ANOVA were carried out for assessment of subjects' characteristics of the three groups. Test of Chi squared was performed for evaluation of allocation of sex among groups. In advance of analysis, test of Shapiro-Wilk was employed to check the data normality.

Variance's homogeneity test of Leaven was performed to evaluate among groups homogeneity which revealed normally distributed data with variance homogeneity. Boxplot showed no data outliers. MANOVA of mixed 3 x 2 design was carried out to examine the impact of treatment (between groups), time (pre versus post) besides the interaction impact on values of mean of measured variables. The significance level for all statistical examinations appointed at $p < 0.05$. Version 20 of the statistical package for social studies (SPSS) for windows (IBM SPSS, Chicago, IL, USA) was employed for all statistical tests.

Results

Participants Characteristics: As revealed in table (1), no significant difference has been detected among groups A, B and C in the mean values of age, weight, height, gender distribution as well as BMI ($p>0.05$).

I- Effect of treatment on quality of life:

Regarding within group effect concerning energy item, there was significant improvement in mean value of Energy by SF-36 within groups A and B post study by 83and 81.6% respectively ($p = 0.001$). no significant difference has been detected in mean value of Energy by SF-36 in group C between pre and post study ($p = 0.999$), the percentage of change was 1.5% (table 2).

Concerning emotion, there was significant improvement in mean value of Emotion by SF-36 within groups A and B by 49.6 and 55.5% respectively ($p = 0.001$). no significant difference has been detected in group C among pre and post study ($p = 0.065$), the percentage of change was 7.5% (table 2.)

For total score of SF-36, there was significant improvement in mean value of SF-36 total within groups A and B post study by 77.6 and 95.3% respectively ($p = 0.001$). While there was no significant difference in group C among pre and post study ($p = 0.069$), the percentage of change was 4.6% (table 2).

Comparing the two groups after treatment showed a statistically significant difference ($p = 0.001$) (table 2). Table 3 shows that the results of the post hoc test showed that although groups A and B were not significantly different from one another ($P=0.637$), groups A and C were significantly different ($p=0.001$) favoring group A, and groups B and C were significantly different ($p=0.001$), favoring group B. Table 2 shows that the groups' mean values of Emotion after the study were significantly different ($p = 0.001$). As shown in table (3), the post hoc test showed that groups A and B were not significantly different from one another ($P=1$), groups A and C were significantly different from one another ($p=0.001$) favoring group A, and groups B and C were significantly different from one another ($p=0.001$) favoring group B. After the study, the groups' mean total SF-36 scores were significantly different ($p = 0.001$), as shown in (table 2). Table 3 shows that the results of the post hoc test showed that groups A and B were not significantly different from one another ($P=1$), groups A and C were significantly different from one another ($p=0.001$), favoring group A, and groups B and C were significantly different from one another ($p=0.001$), favoring group B.

II- Effect of treatment on performance:

Regarding within group comparison, there was significant improvement in mean value of 6MWT within groups A, B and C post study by 26.2, 27.5 and 6.3% respectively ($p = 0.001$) For between groups comparison, Table 2 shows that after the study, the three groups' mean values of 6MWT were significantly different ($p = 0.001$). Table 3 shows that the results of the post hoc test showed that groups A and B were not significantly different from one another ($P=1$), groups A and C were significantly different from one another ($p=0.001$), favoring group A and groups B and C were significantly different from one another ($p=0.001$), favoring group B.

III- Effect of treatment on renal function:

Regarding urea reduction ration (URR) within group, there was significant decline in mean value of URR in groups A, B and C post study by 13.8, 15.9 and 6.3% respectively ($p = 0.001$). Regarding blood urea Nitrogen (BUN) within group, there was significant decline in mean value of BUN within groups A, B and C post study by 19.3, 20.4 and 7% respectively ($p = 0.001$). For Creatinine, there was significant decrease in mean value of Creatinine within groups A and B post study by 17.8 and 25.8% respectively. While here was no significant difference in mean value of

Creatinine in group C between pre and post study (p = 0.206), the percentage of change was 5% (table 2).

Table 2 shows that after the study, the three groups' mean values of URR, BUN, as well as creatinine were significantly different from one another (p = 0.001). Table 3 shows the results of the post hoc test that was used to determine whether groups differed statistically in terms of the average URR values after the study. Groups A and B did not differ statistically (P=1), but groups A and C did differ significantly (p=0.002) favoring group A, and groups B and C did differ significantly (p=0.004) favoring group B.

Groups A and B did not differ statistically from one another (P=1) in terms of post-study mean BUN values; however, groups A and C differed significantly from one another (p=0.001), favoring group A; and groups B and C differed significantly from one another (p=0.001), favoring group B. Groups A and C did not differ statistically from one another in terms of post-study energy by creatinine mean values (p=0.345 and p=0.320, respectively), but groups B and C did differ significantly from one another (p=0.006), favoring group B.

Table 1. General characteristics of subjects of three groups.

Subject characteristic	Group A	Group B	Group C	f-value	p-value
Age (years)	45.2±3.4	44.2±2.9	44.7±3	0.557	0.576
Weight (kg)	75.2±10.4	77.3±10.3	71.3±9.7	1.81	0.172
Height (cm)	170.4±8	170.2±8.3	165.2±11.5	1.97	0.148
BMI (kg/m²)	25.8±3.9	26±2.3	26.2±4	0.087	0.917
Sex N (%)				χ^2 =0.141	0.932
Males	13 (65%)	12 (60%)	12 (60%)		
Females	7 (35%)	8(40%)	8 (40%)		

Table (2): Comparison between pre- and post-study mean values of measured variables between and within groups

Measured variables	Group A	Group B	Group C	f-value	P value	η²
SF-36 (Energy)						
Pre-study	31±11.9	28.2±9.4	34±11.5	1.352	0.267	0.045
Post-study	56.7±12.5	51.2±13.7	34.5±14.9	14.821	0.001*	0.342
% of change	↑83%	↑81.6%	↑1.5%			
(P-value)	0.001*	0.001*	0.999			
SF-36 (Emotion)						
Pre-study	46.6±11.5	43.6±11.3	49.2±11.7	1.175	0.316	0.040
Post-study	70.7±12	67.8±9.1	52.9±12.6	14.118	0.001*	0.331
% of change	↑49.6%	↑55.5%	↑7.5%			
(P-value)	0.001*	0.001*	0.065			
SF-36 (total)						
Pre-study	292.5±62.7	261.3±46.7	302.5±58.5	2.907	0.063	0.093
Post-study	519.6±46	510.3±37.9	316.4±53.9	122.061	0.001*	0.811
% of change	↑77.6%	↑95.3%	↑4.6%			
(P-value)	0.001*	0.001*	0.069			
6MWT (meter)						
Pre-study	274.1±15	269.4±11.1	265.8±13.8	1.912	0.157	0.063
Post-study	345.8±24.7	343.6±20.2	282.5±14.9	62.172	0.001*	0.686
% of change	↑26.2%	↑27.5%	↑6.3%			
(P-value)	0.001*	0.001*	0.001*			
URR						
Pre-study	70.4±8.6	72.8±8.4	74.3±10.8	0.880	0.420	0.030
Post-study	60.7±8.1	61.2±8.5	70.6±9.7	8.001	0.001*	0.219
% of change	↓13.8%	↓15.9%	↓5%			
(P-value)	0.001*	0.001*	0.014*			
BUN (mg/dL)						
Pre-study	134.6±11.8	138.7±12.5	138.1±11.3	0.680	0.511	0.023
Post-study	108.6±10.3	110.4±12	128.4±10.3	19.933	0.001*	0.412
% of change	↓19.3%	↓20.4%	↓7%			
(P-value)	0.001*	0.001*	0.001*			
Creatinine (mg/dL)						
Pre-study	9±1.8	8.9±1.4	8.4±1.7	0.655	0.523	0.022
Post-study	7.4±1.3	6.8±1	8±1.1	5.249	0.008*	0.156
% of change	↓17.8%	↓25.8%	↓5%			
(P-value)	0.001*	0.001*	0.206			

Data is represented as mean ±SD, SF-36: Medical Outcome Study Questionnaire, 6 MWT: 6 minute walk test, URR: Urea reduction ratio, BUN: blood urea nitrogen
*: significant, η2: partial eta square

Table (3): post hoc test between groups of measured variables post-study

Post hoc between groups		SF-36 Energy	SF-36 Emotion	SF-36 Total	6MWT	URR	BUN	Creatinine
Group A vs. B	Mean difference	5.5	2.9	9.3	2.1	-0.49	-1.8	0.61
	P-value	0.637	1	1	1	1	1	0.345
Group A vs. C	Mean difference	22.7	17.8	203	63.3	-9.9	-19.7	-0.625
	P-value	0.001*	0.001*	0.001*	0.001*	0.002*	0.001*	0.320

Group B vs. C	Mean difference P-value	17.2 0.001*	14.9 0.001*	193.8 0.001*	61.1 0.001*	-9.4 0.004*	-17.9 0.001*	-1.2 0.006*

SF-36: Medical Outcome Study Questionnaire, 6 MWT: 6 minute walk test, URR: Urea reduction ratio, BUN: blood urea nitrogen *: significant, vs: versus, *: significant

DISCUSSION

Knee osteoarthritis represents a The research team wanted to see how hemodialysis patients' quality of life, physical performance, and renal function (URR, blood urea nitrogen, and creatinine) would change after participating in either Whole Body Vibration or resistive exercise.

The Mashtoul Al-Souk Centeral hospital in Alsharkia, Egypt, was the site of this research.

The patients were randomized into three groups: Group (A) composed of 20 patients who were given resisted exercise using ankle free weights for lower limb muscles, 3times-weeks for 12 weeks, group (B) consisted of 20 patients who were given Whole-body vibration training (WBVT) for 3 times -week for 12 weeks and group (C) composed of 20 patients who received conventional physical therapy program (aerobic exercise and breathing exercises).

The finding of the present study showed that:

According to research by Baio et al., [14], patients undergoing short daily hemodialysis treatment as part of their treatment regimen, individuals might experience slight improvements in BMI, BMR, as well as timed-up-and-go efficiency when they engage in supervised intradialytic resistance training.

For CKD patients, resistance training for 8 weeks throughout the intradialytic phase was more effective than stretching for a control group, according to Exel et al. [15]. This was due to the fact that resistance training improved functional capacity in addition to lower-extremity muscle strength.

Jamshidpour et al. [16] shown that a safe therapy technique that can be used to promote overall physical function while maintaining muscle strength in Type 2 diabetic hemodialysis patients includes 8 weeks of combination of aerobic as well as resistance exercise training throughout the 1st 2 hours of hemodialysis. As a result, this approach may be useful in reducing the likelihood of hospitalization and mortality among this complex patient population.

WBV exercise training has been shown to improve physical fitness as well as static and dynamic balance control in people with maintenance HD by Yang et al., [10]. The research also revealed that WBV exercise might be a feasible and beneficial training strategy for young persons on dialysis. This data may serve as the foundation for future guidance and rehabilitation services for young dialysis patients.

WBV intervention improves motor function, muscle strength, and bone-muscle connection, as shown by Coelho-Oliveira et al., [17].

Physical function, aerobic capacity, dialysis adequacy, and HRQOL may all be enhanced with combined aerobic and resistance training, according to research by Liu et al., [18]

Patients on hemodialysis for chronic renal disease may enhance their physiological state by participating in a resistance training program for at least eight weeks, as determined by the research of ALkhaqani, [19]

Chronic hemodialysis patients' physical performance and quality of life were shown to improve with a 12-month intradialytic exercise program that included endurance and strength training, compared to normal treatment.

Based on the results of strength, exercise capacity, and physical performance tests, Segura-Ort et al. [20] concluded that an intra-dialytic resistance training program is feasible and effective in enhancing physical functioning

Patients with CKD may be treated with the WBV. The WBV program has been proved to be successful, well-received, safe, and well-tolerated. These results provide credence to the use of WBV in CKD: Kidney transplantation. The walked distance. Muscle fatigue. Exercise. Life satisfaction.

Patients receiving renal transplantation were shown to have sufficient improvements in heart rate variability as well as performance on maximal and submaximal tests after 12 weeks of training with WBVT sessions two times per week (Maia et al., [21]). Given the high prevalence of arrhythmias and sudden mortality in this group, WBV may be an alternative to traditional ways of physical exercise.

Exercising on the WBV platform may enhance college students' quality of life by decreasing their levels of sadness, anxiety, and tension. (Chawla et al., [22]. Students may be interested in the WBV treatment model because it is low-cost, easy-to-implement, safe, requires just a few minutes every session, and yields positive outcomes in a relatively short amount of time.

WBV was shown to enhance HRQOL in patients with chronic illnesses by Li et al. [23]. Nonetheless, additional high-quality studies with bigger sample numbers and longer treatment durations
The research did not involve any financial interest or benefits for the author.

Conflict of interest

The authors have declared that they do not have any conflict of interest.

are required to substantiate recommendation.

Asahina et al., [24], who investigated the impact of WBV on walking capability and balance in elderly hemodialysis patients, concluded that it did not enhance either measure. Our study's results contradict their findings.

CONCLUSION

According to the findings of the investigation:

Post-treatment, both Groups A and B showed considerable improvements over the control group in terms of energy, mood, the sum of Sf 36, and the 6-minute walk distance (6MWT). Creatinine levels decreased significantly in group B compared to the control group, while there was no significant difference in creatinine levels among groups A and B. The mean values of BUN, creatinine, URR, energy, emotion, total Sf 36, and 6MWT were not significantly different between groups B and A.

It follows that dialysis efficiency and performance may be enhanced by the use of both whole-body vibration and resistive training exercise. There was absolutely no change after therapy between the two groups.

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