Exploring the Interplay Between Psychological Distress and Clinical Outcomes in Individuals Undergoing Maintenance Hemodialysis for End-Stage Renal Disease

Jufang Song[1], Yang Yu[2], Rong Zhu[3]

[1]Department of Nephrology, Longhua Hospital, Shanghai University of Traditional Chinese Medicine,resident physician, China
[2]Department of Oncology, Longhua Hospital, Shanghai University of Traditional Chinese Medicine,chief physician，China
[3]Department of Nephrology, Longhua Hospital, Shanghai University of Traditional Chinese Medicine,chief physician，China

Introduction. Investigating the relationship between psychological distress and clinical outcomes in patients receiving maintenance hemodialysis for end-stage renal disease.
Methods. This research used a cross-sectional survey approach. Questionnaires with a clear structure were given to patients undergoing hemodialysis in order to examine their level of physical activity and to examine how physical activity relates to negative feelings. A purposive sampling method was used to choose outpatient patients undergoing hemodialysis. This research included 100 patients who were above the age of 20, had been receiving hemodialysis therapy for at least 4 months with weekly sessions lasting 4 hours, had the cognitive ability to complete the questionnaire, and were able to voice their ideas vocally.
Results. Their BMI (SD) was 23.88±3.54 kg/m2, their Kt/V score was 1.53±0.23, their nPCR score was 1.21±0.31 g/kg/d, their BUN score was 69.03±6.76 mg/dL, their creatinine level score was 10.03±1.98 mg/dL, and their albumin score was 4.04±0.54 g/dL. The average duration of their chronic kidney disease (standard deviation) after diagnosis was 13.21±1.43 years. The average duration of their hemodialysis was 5.77±1.43 years. Out of the participants, a CCI-based examination showed that 48 patients (48%) had comorbidities. Regarding the BAI scores (3.25, SD = 2.24), the following factors were found to have a negative correlation: being female [2.31(0.79-3.52), 0.006], having more than 12 years of education [−3.42(-5.62--3.51) 0.002], being currently employed [−3.05(-5.63-2.84) 0.003], having a monthly income of more than NT$50,000 [−4.89(-7.53-0.54) 0.04], hemodialysis duration [-0.37(-0.71-0.55) 0.04], and a weekly energy expenditure of ≥600 MET [−4.72(-5.61-2.74)0.002].
Conclusion. The relationship between psychological distress and clinical results in persons receiving maintenance hemodialysis for end-stage renal disease (ESRD) is intricate and substantial. To effectively manage psychological distress, it is essential to use a mix of therapy interventions,

pharmaceutical therapies, and strong support networks. This approach is vital for promoting adherence to treatment, minimizing morbidity, and increasing overall quality of life.

Keywords. Psychological Distress, Hemodialysis, End-Stage Renal Disease

INTRODUCTION

Risk of worse renal illness and severe treatments like hemodialysis lead to various modifications in both the physical and the emotional aspects such as the psychological view of the patient receiving the treatment and their review of quality of life. The efficacy of a hemodialysis treatment is judged by its performance on the basis of the way following which the patient's life is sustained despite the existent end-stage renal failure. By the dint of its long-lasting effect, we aim to solve also bodily issues as well as mental problems. The fact that the evaluation of the life quality of patients grants the medical team an ability to get an extensive view on patients beyond their ailments, becomes an important stimulant. By this, it develops the patient-doctor/physician relationship [1-3] for a strong basis.

And afterall, patients with ESRD who are undergoing hemo-dialysis are likely to encounter a number of psychological problems including depression, anxiety as well as reduced physical quality of life. A large number of hemodialysis patients are afflicted with this disorder, thus the incidence of depression is high: the data indicate that among the patients who undergo hemodialysis, more than 3 out of 10 have apparently significant depressive symptoms. In addition to it, the great numbers of the group itself are suffering from the depression and other emotional problems including the anxiety. Multiple causes contribute to this psychological distress: The anguish and powerlessness with ESRD in end of renal function (ESRD) and the constant and strenuous hemodialysis schedule are strong enough to cause stress and anxiety. Having the fatigue, dis-ease and other physical suffering symptoms that appear due to the illness and the treatment be caused, can play a role of great psychological day out. Being pushed to comply with a new lifestyle may give rise to feelings like annoyance, anger and loss of control as a result of dietary changes, water intake regulation, moreover freedom loss. The involvement of dialysis might affect social gathering attendance if it persists as well as interpersonal connections, causing feelings of isolation and loneliness[6,7].

The influence of psychological distress on clinical outcomes: Psychical health of hemodialysis patients tends significantly towards their medical treatment outcomes. Psychological distress may have adverse effects on these outcomes via many mechanisms: For those undergoing hemodialysis for low grade depression or anxiety can often show a loss

of interest in going for treatment regularly, maintaining food limitations, and taking the medication schedule seriously which can lead to adverse health implications[8]. Psycharigutune is associated with the increase in the cases of admissions and problems. Depression among hemodialysis patients is frequently observed as acomplex pathology that encompasses increased inflammation and is often linked with cardiovascular events. Data have revealed that the highest mortality risk has been associated with people that have sadness and anxiety while almost at the end life due to chronic kidney disease (ESRD). The thoroughgoing interplay of psychological and physical pressures may be the determining factor for mortality. However, addressing the psychological aspect of ESRD patients must be the key focus as it is an integral factor that will determine the quality of life and a possible positive clinical result among end-stagers who are on hemodialysis. Given that treatment methods like Cognitive-behavioral therapy (CBT) and mindfulness-based stress reduction can be used to help patients overcome depression and anxiety, can be an effective component of the program. Whether or not antidepressants and anxiolytics are good options in some cases, they need to be closely monitored since these medicines may react or interfere with other medicines, thus having different effects on ESRD patients when it comes to the break down of drugs in the body [9, 10].

Mental issues, including the tendency to have depression, anxiety, and even emotional parasomnia, are the frequent phenomena seen in patients given the hemodialysis procedure. The severity of inflammation is very high in such patients who also have other chronic medical conditions. This, in turn, can increase the risk of death for these sick patients. Patients might feel fathomable fatigue when they have done the hemodialysis. Studies have shown that chronic fatigue could be due to anemia, wrong dialysis sessions, medical disorders and others, including high blood pressure, diabetes, and heart disease [11]. Consequently, people on hemodialysis program may show having diurnal somnolence, initial symptoms of the depression, and long-term fatigue. Between 42-89% of the patient pool in a hemodialysis session gets tired and its a regular disruption in their daily activities. Thus, tiredness and mental exhaustion are the closely related process where both of them affect each other that is somewhat complicated [12]. Studies have shown that the probability of depression in people on hemodialysis is three to four times higher ratio compared to those who do not go through haemodialysis. Such a physiological behaviour in patients undergoing haemodialysis's perhaps a reflection of the physical loads they endure caused by CKD, which leads to a low physical quality of life and manifests in various impairments. In various studies this cohort is known to be the most anxious among the continuous hemodialysis patients and

it was found out that around 43% of them have anxiety disease. Almost after 90%, and usually the sadness is added to their anxiety. The anxiety brought on by the treatment may even negatively affect the level of home hemodialysis therapy they follow and compromise their capability to handle the problem, causing undesirable implications [13].

The loss of physical activity induces a loss in physical function in patients on hemodialysis to a great extent. The chances of developing health problems in the patients who are not involved in any kind of exercise are many times more. In the light of these facts, the World Health Organization's 2020 Guidelines consider them provides refreshed recommendations about physical activity for those with chronic illness, anxiety or depression that is addressed. The new guidelines call for moderate-intensity exercises and high-intensity, physical workouts of 150-300 minutes and 75-150 minutes, respectively, spread across 5–7 days throughout the week to avoid diabetes, high blood pressure and psychological stress. Besides, increasing the patient participation work in the daily life and trying to free patients from the CKD burdens is supposed to help in achieving the mission of "Living Better with Kidney Diseases" according to the World Kidney Day joint steering committee.[14].

MATERIALS AND METHODS

Through this study, the application of a cross-sectional survey approach was done. To get answers on the patients' level of physical activity and see if it correlates with the bad feelings patients undergoing hemodialysis were given questionnaires with evident structure. A purposive sampling method was the approach on choosing the outpatient patents who were undergoing hemodialysis. Of which the researcher included people who were above twenty years old, had been on hemodialysis sessions of at least 4 months, and these sessions lasted for 4 hours. This test was composed of people that could do it cognitively; they could write or complete the questionnaire and who could also express themselves vocally. Patients diagnosed cognitive difficulties or mental illness, reportedly unable to manage the questionnaire, with diseases, incompetent level of self-care cases, or now undergoing treatment in inpatient facility were not included in the research. The classroom was divided into small groups each comprised of a teacher or authority. The teacher performed a testing process on every participant and those who met the required criteria were invited to participate in the survey. In this research, participants were the ones recruited after getting the green light from the gentlemen or ladies of the recognized ethics committee. The volunteers gladly took part in the research they never felt obligated to buy all the necessities and adult toys. Besides this, participants could discontinue the study participation whenever they

wanted as far as their right to receive medical care in the future would be respected. The researcher was very transparent with the study objectives, and projected a clear understanding about the study to the group who opted to participate in the study.

Fundamental Parameter

As for the demographic factors, of the participants, we had age, gender, education level, marital status, living arrangement, current employment, monthly income, body mass index (BMI, kg/m2), presence of chronic diseases (hypertension and diabetes), their being in regular physical exercise (3 times per week), and the duration of their hemodialysis (in years). The biochemical data investigated in participants include measurements of the efficiency of dialysis (Kt/V), nPCR, hemoglobin level (mg/dL), BUN (mg/dL), creatinine level (mg/dL) and albumin level (g/dL) [15].

Charlson Comorbidity Index

The Charlson Comorbidity Index (CCI) considers the weights of 19 conditions that coexist and their correlation with death, and it is applied across various fields to determine the severity of comorbidities. The CCI assigns 1 point for a patient with past medical history of any of the following: myocardial infarction (heart attack), congestive heart failure (CHF), peripheral vascular disease (PVD – condition when blood vessels become damaged), cerebrovascular disease (CVD – condition when blood supply to the brain is disrupted), dementia (loss of cognitive abilities), chronic pulmonaryThe patients with hemiplegia are second ranked, renal diseases with moderate or severe grade, any type of tumor, leukemia, and lymphomas. 3 points are added to the sickness severity score for the patients with end stage or advanced liver disease. Therefore, 6 markers are applied to cancer patients diagnosed with metastatic solid tumor or those whose immune system is being weakened or destroyed. The CCI in this case gave a high agreement of weighted kappa coefficient of 0. The 95% confidence interval is [0. 667, 0. CCI, the standard tool here, was employed to measure the seriousness of comorbidities in patients during hemodialysis (596-0. 714). The CCI provided number of diseases that patients likely had and it was considered above threshold [16]

Measurement of physical activity

This present research the International Physical Activity Questionnaire—Short Form as the appropriate tool to determine whether the particular individuals are active or not. In the questionnaire, the time period for participants was limited to the duration of their physical

activity (7 days before the persons completing the questionsnaire). Moreover, it scored their quantity and intensity of physical activity particularly low-intensity (≤600 metabolic equivalent of task [MET]-min/week), moderate-intensity (between ≥600 and < 3000 MET min/week) movements, and also vigorous-intensity sedentary behavior (≥3000 MET min/week). The author also used activity integration score as an additional assessment. MET intensity (kcal/h/kg) was measured by multiplying participant weight with metabolic equivalent of the physical activity undergone and the length of the exercise [17]. According to IPAQ-SF, it is demonstrated that the stability seems impressive. The questionnaire was having a retest reliability of 0. Score 1 indicates 8 and a validity of criterion 0. 30 according to a Spearman`s rho correlation - a statistical test. Hence, accuracy and effectiveness of questionnaire is validated by the above analysis.

Depression Assessment

Beck's Depression Inventory-Second Edition (BDI-II), which was originally constructed by Beck and his colleagues, was employed to quantify the depth of depression among the subjects. In 2000, the Chinese version of the questionnaire was issued as the Psychometric Corporation released it. The first function of the BDI-II was to determine an assessment of depression levels as well as cognate functioning and somatic sensations encountered by the participants during the two week period prior to the current investigation. The questionnaire has 21 items with 2 choices for each of them. The score system for every problem is based on the variety of answers provided by the participants and is represented using a 4 points-scale starting from zero and ending at 3 points. The entire score goes from 0 to 63 and has the following ranges; little depression 14 to 3, medium depression 14 to 28, and mild level depression 29 to 63 [18]. The latest research result obtains that the Cronbach's alpha coefficient values of Chinese version of BDI-II are the 0 %.

Anxiety Assessment

As now research was done with BAI (Beck Anxiety Inventory) measuring anxiety levels. The Beck and Steer scale was initially issued in 1987 and afterwards purchased by The Psychological Corporation in 200 for the purposes of disclosing its Chinese version. The measures entail 21 items and the individuals responses are evaluated using a four point scale which ranges from 0 to 3 (0 = not at all; 1 = slightly; 2 = significantly,; 3 = severely). The scale, which spans 30–63, from minimum to severe anxiety levels, is rated into 4 bands with 0–9, 10–18, 19–29 representing mild, moderate and severe levels respectively. According to present

investigation, the Cronbach's alpha coefficient that Chinese version of BAI was 0. Ht is 90, which indicates that the measure includes sufficient reliability.

Fatigue Assessment

Those participants on the BFI-T to record the tiredness intensity, it utilized the Brief tiredness Inventory Taiwan version. The wheel has nine yogas and it is divided into two parts. That first phase allows for a total response that is based on an evaluation of the present weariness experienced by the participant which is in reference to their usual level of tiredness preceding the taking of the tool and the severest degree of fatigue in the same day prior to the administration of the instrument. The average grade of the grades obtained in all these three things is used towards declaring the overall score. The second section of the scale consists of six items that assess the extent to which fatigue disrupts the lives of respondents across six dimensions: cognitive right, silent walks, normal working, house works outside and normal tasks, interactions with people, and enjoyment in life. The mean value of the outstanding scores for these six items was used as the final score. Points of scoring were attributed to every item in the 11-level Likert scale. For the first segment of the scores range between 0 and 10 with 0 representing no tiredness, 1-4 suggesting tiny exhaustion, 5-6 showing moderate fatigue , and 7-10 signaling clear fatigue. The second segment of the scale depicts higher scores means a more severe disruption. Here, we should show weariness scores, which are 0, 1-4, 5-6, and 7-10. This implies no or mild, moderate and severe weariness levels and identifies interference with different ones. The present study obtained the Cronbach's alpha scores between 0. 48 and 0. 74 for the Chinese version of the BFI-T. 90 and 0. The tiredness dimension was assessed using 0 for not tired to 92 for extreme tiredness while fatigue interference was rated in the scale up 0 to 100 in which 0 is the least disruption of the symptom to 100 is the worst interference.

Data Analysis

The number crunching process was done by using the SPSS version 25. In the experiment 0 (SPSS, Chicago, IL, US) where the level of significance was 0. 05. Descriptive statistical information that was collected included the participants' sociodemographic (e. g. , age, gender, etc.) and activity data (physical scores, anxiety, depression, feeling exhausted). The scores provided were numerical and were documented in terms of percentages, means, standard deviation or range. Further, Inferential Statistics were done using a t-test in a two independent group and Generalized Linear Modeling. The sort of univariate linear regression analysis was used to establish the correlation between the comorbidities, sociodemographic

factors, and physical activity levels, depression, anxiety, and exhaustion ratings. There were lots of datasets analyzed by linear regressions considering sociodemographic characteristics as age, gender, education level, marital status, unemployment, and monthly income, together with those restricting to kidney function (Kt/V, nPCR, hemoglobin level, BUN, creatinine level, albumin level), daily lifestyle (regular physical activity), treatment duration (duration of hemodialysis),As for the primary exposure variables, Generalized linear model was used. The model was fitted to assess the association of emotional domains (anxiety, depression, and exhaustion) and physical activity with General health questionnaire. Thus, this approach is very unusual because it is fit for nonlinear normal distributions.

RESULTS

By way of a total of 115 individuals undergoing hemodialysis who agreed to participate in the study, the data collection process occurred over a certain period of time. However, next five did not write these questions, and there were 15 cases when attitudes to literacy of individuals did not corresponded to the level of their illiteracy. Under the approach that I cleared the respondents from individuals mentioned below, we collected the completed questionnaire from 100 patients that were undergoing hemodialysis. With respect to Table 1 and Fig 1, which conversations the characteristics of demographic of the 100 patients on hemodialysis, we are going to illustrate the features of demography; such as gender, age, nationality, and the level of education, among the dialysis patients. Th average age of the participants was 60 respectively. 99±6. 74 years. Two third of them were men (78%), were senior high school graduates or equivocal (64%), in a relationship with their spouses (65%) and lived with their family members (95%). The rest of them boats were unable to make their end meets (about 83%) and had a monthly income of below NT$55,000 (88%). BMI (SD) of their -23. Their homozygous mutation, p. Ser88del in exon2, results to Kt/V 1. Their nPCR score was 1. 03±0. However, the patients on renal dialysis presented BUN score at 21±0. 31 g/kg/d which was 69. 1. 65 - 2. 59 mmol/L of creatinine level, the creatinine level score was 10. Blood pressure 140/90 mmHg, Hemoglobin A1c 6. 4%, and their Albumin score of 4. 04±0. 54 g/dL. On the other hand, the mean time of chronic kidney disease (±standard deviation) of the patients are 13. 21±1. 43 years. The patients helplessly waited for their turn and the duration of their hemodialysis was 5. 77±1. 43 years.

There were a total of 48 patients (48%) from the participants which clinical comorbidities (CCI) tested out positive for various diseases. The present hypertension disease was the most common comorbidity, which was found in the cardiovascular patients in 78% of

the cases. The diseases which were second, third and fourth in the prevalence list, were diabetes (48%), peripheral vascular disease (43%), and congestive heart failure (35%), which were followed by other conditions (20%). However, only 52% of the checked group of 52 members where the members reported their physical activities regularly. Nevertheless, 48 persons (48% of the entire pool) have energy triage of over 600 MET/week, accounting for 60% of the whole pool. The participants as a group with an average BDI-II scores of 6 displayed high levels or depression. The result of the research is that the mental health of the water level manipulation group was higher, in the treatment group average BAI scores were 3. 34 (SD=1. 09).

Table 1 Basic profile of participants

Parameter	Number	Percentage
Age (years)		
Below 55	37	37
Above 55	63	63
Gender		
Male	78	78
Female	22	22
Qualification		
Up to 12th	36	36
Graduation and above	64	64
Marital status		
Unmarried	35	35
Married	65	65
Family status		
Nuclear	10	10
Joint	90	90
Status of employment		
Employed	17	17
Unemployed	83	83
Monthly income/(NTD)		
Below 55000	88	88
Above 55000	12	12

BMI, kg/m^2		
Below 25	67	67
25–29.9	24	24
Above 30	9	9
Biochemical data		
Kt/V	1.53±0.23	
nPCR (g/kg/d)	1.21±0.31	
Hemoglobin (mg/dL)	12.43±2.54	
Blood urea nitrogen (BUN; mg/dL)	69.03±6.76	
Creatinine (mg/dL)	10.03±1.98	
Albumin (g/dL)	4.04±0.54	
Comorbidities		
Yes	48	48
No	52	52
Comorbid conditions		
HTN	78	78
DM	48	48
Peripheral vascular disease	43	43
Heart problem	35	35
others	20	20
Duration of CKD (years)	13.21±1.43	
Regular Physical activity (3 times/week)		
Yes	52	52
No	48	48
Duration of hemodialysis (years)	5.77±1.43	
Physical activity (MET-min/week)		
Above 600	44	44
Below 600	56	56
BDI-II	6.03±1.32	
BAI	3.34±1.09	
BFI-Taiwan version		
Fatigue severity	3.65±1.12	
Fatigue interference	2.32±0.87	

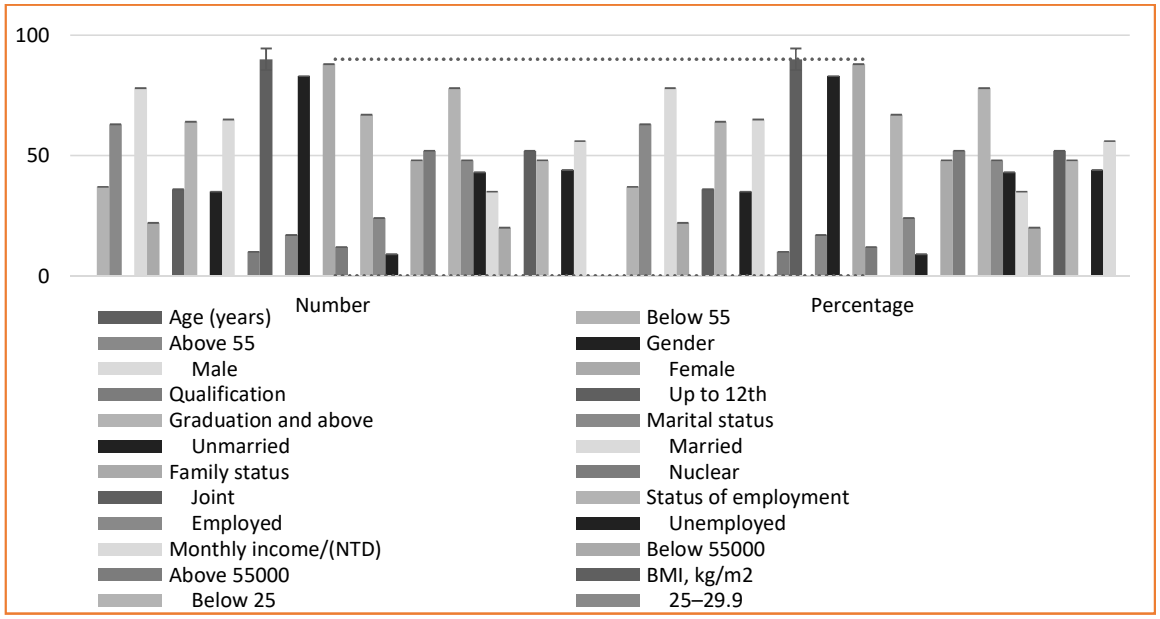

Figure 1 Basic profile of participants

Scoring values were subjected to a multivariate statistical analysis at the end to correct for unknown confounding socio-demographic and fitness parameters. Grimly, there was an important statistical significance between the patients with comorbidities who underwent hemodialysis with the ratings in sadness ($p < 0.001$), anxiety ($p < 0.$ Respiratory comorbidity ($p=0.002$) and tiredness severity ($p = 0.01$) are the only symptoms of the disease that differentiate patients with COIVD-19 a comorbidity from those without. The experiment never showed that the difference in tiredness was because of their different groups. Future implications are that patients older than 65 years, irrespective of their race, on a maintenance hemodialysis who have an exercise capacity of 600 MET or higher may require innovative approaches like promoting physical activity can help prolong life. This disparity had effect in quality life of them ($p < 0.05$). Anxiety ($p <001$) is the second most common reaction to solitude, which we blamed on 001). It also found a discriminant ability of jointedness ($p = 0.001$), and tiredness severity ($p = 0.01$). Comparing the two groups, no significant difference concerning fatigue inexistence was observed among the subjects with ≥600 MET and their unmatched counterparts, as is illustrated in the picture and table.

Table 2 Investigation of the variables linked to the score of the Beck Depression Inventory-Second Edition and basic features

Parameter	B (95% CI)	p
Age (years)	0.21(0.11-6.57)	0.007
Gender	2.88(0.99-4.98)	0.009
Education	−4.17(-6.99--2.98)	0.003
Marital status	−76(-6.99--2.98)	0.054
Living arrangement	−98(-3.89-6.18)	0.72
Employment status	−4.65(-6.23-2.18)	0.005
Monthly income/(NTD)	−5.72(-7.11-0.24)	0.05
BMI, kg/m2	0.12(-0.24-0.42)	0.32
Biochemical data		
Kt/V	−8.52(-6.94--1.23)	0.03
nPCR (g/kg/d)	−5.43(-3.61-3.42)	0.76
Hemoglobin (mg/dL)	−1.43(-1.44-0.74)	0.34
Blood urea nitrogen (mg/dL)	0.01(-0.05-0.66)	0.56
Creatinine (mg/dL)	-0.64(-0.32-0.85)	0.43
Albumin (g/dL)	−1.57(-5.62-2.11)	0.42
Comorbidities	-2.11(-2.02-3.01)	0.32
Regular Physical activity (3 times/week)	-1.41(-4.42-1.32)	0.25
Duration of hemodialysis (years)	-31(-76-0.32)	0.03
Physical activity (MET-min/week)	−4.35(-5.64-2.42)	0.001

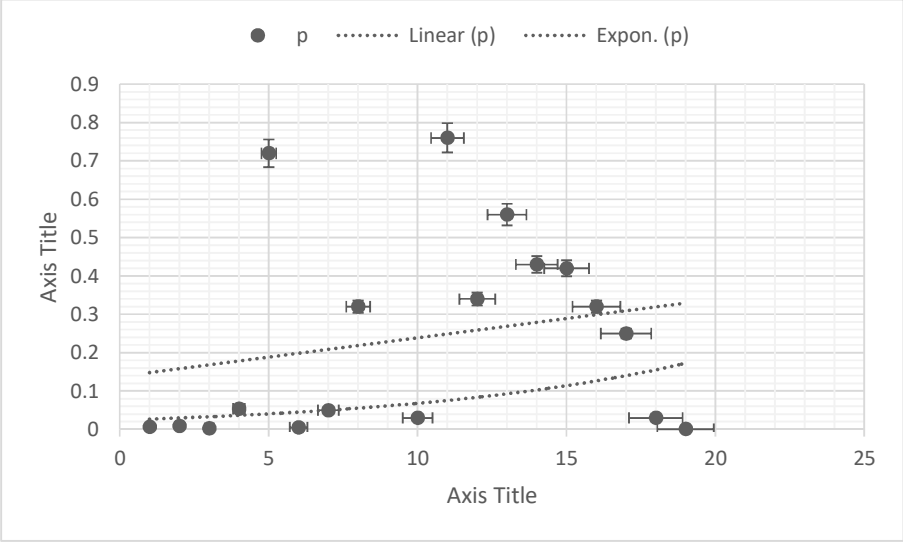

Fig 2: Investigation of the variables linked to the score of the Beck Depression Inventory-Second Edition and basic features.

The findings of a univariate linear regression analysis are shown in Table 3. Regarding the BAI scores (3.25, SD = 2.24), the following factors were found to have a negative correlation: being female [2.31(0.79-3.52), 0.006], having more than 12 years of

education [−3.42(-5.62--3.51) 0.002], being currently employed [−3.05(-5.63-2.84) 0.003], having a monthly income of more than NT$50,000 [−4.89(-7.53-0.54) 0.04], hemodialysis duration [-0.37(-0.71-0.55) 0.04], and a weekly energy expenditure of ≥600 MET [−4.72(-5.61-2.74)0.002] (Table 3 and Fig 3).

Table 3 Investigation of variables linked to Beck Anxiety Inventory score and fundamental features

Parameter	B (95% CI)	p
Age (years)	0.12(0.06-5.07)	0.006
Gender	2.31(0.79-3.52)	0.006
Education	−3.42(-5.62--3.51)	0.002
Marital status	−86(-5.05--3.51)	0.04
Living arrangement	−91(-2.19-5.32)	0.63
Employment status	−3.05(-5.63-2.84)	0.003
Monthly income/(NTD)	−4.89(-7.53-0.54)	0.04
BMI, kg/m2	0.14(-0.31-0.51)	0.29
Biochemical data		
Kt/V	−7.12(-5.98--1.89)	0.04
nPCR (g/kg/d)	−4.13(-3.52-3.54)	0.31
Hemoglobin (mg/dL)	−1.65(-1.23-0.89)	0.17
Blood urea nitrogen (mg/dL)	0.02(-0.06-0.76)	0.27
Creatinine (mg/dL)	-0.44(-0.27-0.75)	0.31
Albumin (g/dL)	−1.61(-4.78-3.42)	0.17
Comorbidities	-2.54(-2.54-3.26)	0.19
Regular Physical activity (3 times/week)	-1.65(-4.64-1.72)	0.16
Duration of hemodialysis (years)	-37(-71-0.55)	0.04
Physical activity (MET-min/week)	−4.72(-5.61-2.74)	0.002

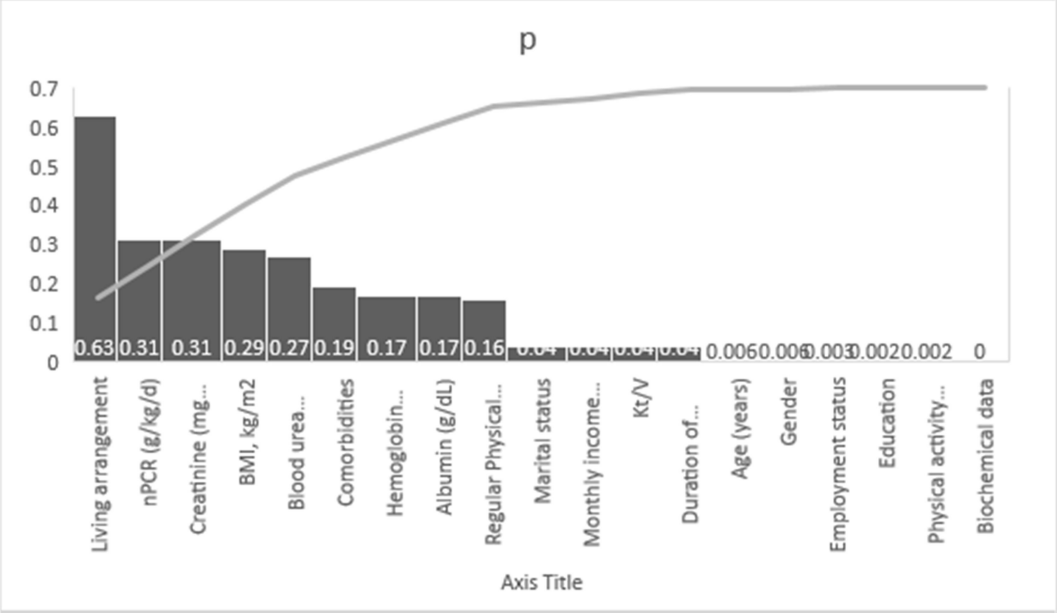

Fig 3: Investigation of variables linked to Beck Anxiety Inventory score and fundamental features

The results of a univariate linear regression analysis are presented in Table 4. The BFI-T scores showed a negative correlation with greater dialysis efficiency and regular weekly physical activity, whereas they showed a positive correlation with Kt/V. The fatigue interference scores of the BFI-T showed a negative correlation with increased dialysis efficiency and regular weekly physical activity, while Kt/V showed a positive correlation (Table 4 and Fig 4).

Table 4 Investigation of the parameters linked to scores on the Brief Fatigue Inventory-Taiwan version and sociodemographic characteristics

Parameter	B (95% CI)	p	B (95% CI)	p
	Fatigue Severity		Fatigue Interference	
Age (years)	0.43(0.23-4.65)	0.009	0.11(0.05-5.12)	0.005
Gender	1.54(0.99-2.98)	0.008	2.22(0.69-3.22)	0.005
Education	−2.16(-3.87--2.21)	0.001	−3.52(-5.16--3.84)	0.001
Marital status	−55(-3.72--2.46)	0.03	−81(-5.31--3.91)	0.03
Living arrangement	−67(-1.76-6.72)	0.67	−78(-2.65-5.17)	0.21
Employment status	−1.38(-4.49-2.55)	0.002	−3.11(-5.21-2.65)	0.002
Monthly income/(NTD)	−3.29(-6.93-0.76)	0.03	−4.29(-7.23-0.54)	0.03

BMI, kg/m2	0.14(-0.23-0.61)	0.23	0.14(-0.33-0.53)	0.41
Biochemical data				
Kt/V	−8.43(-4.38--1.98)	0.03	−7.17(-5.98--1.82)	0.03
nPCR (g/kg/d)	−3.65(-3.87-3.84)	0.41	−4.16(-3.54-3.24)	0.22
Hemoglobin (mg/dL)	−1.78(-1.44-0.95)	0.21	−1.45(-1.43-0.81)	0.18
Blood urea nitrogen (mg/dL)	0.02(-0.05-0.86)	0.34	0.02(-0.06-0.76)	0.17
Creatinine (mg/dL)	-0.31(-0.14-0.89)	0.44	-0.46(-0.24-0.79)	0.61
Albumin (g/dL)	−1.32(-4.89-3.73)	0.21	−1.54(-4.79-3.27)	0.43
Comorbidities	-2.76(-2.12-3.74)	0.27	-2.57(-2.98-3.22)	0.65
Regular Physical activity (3 times/week)	-1.52(-4.48-1.95)	0.21	-1.61(-4.44-1.52)	0.34
Duration of hemodialysis (years)	-0.35(-0.70-0.57)	0.03	-37(-74-0.45)	0.03
Physical activity (MET-min/week)	−4.93(-5.12-2.23)	0.001	−4.52(-5.41-2.34)	0.002

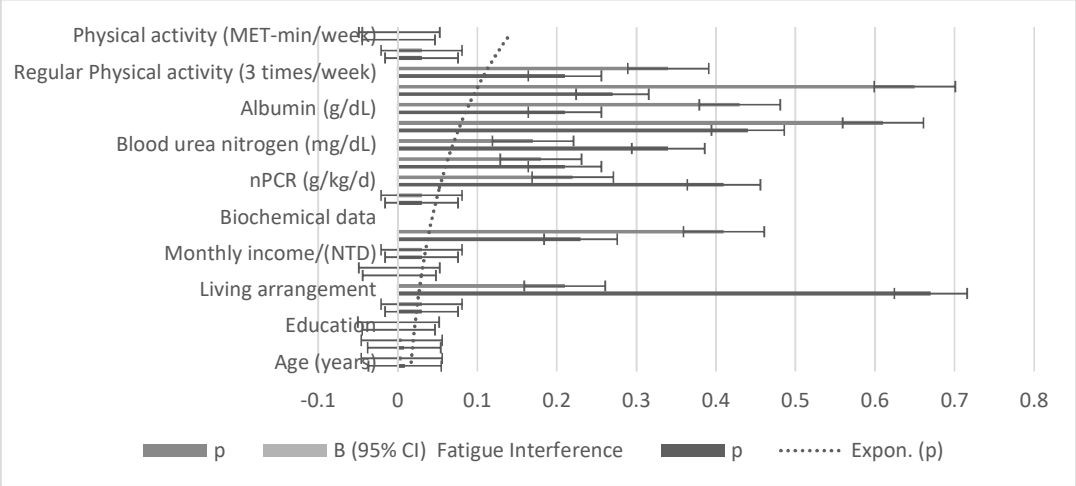

Fig 4 Investigation of the parameters linked to scores on the Brief Fatigue Inventory-Taiwan version and sociodemographic characteristics

Figure 5 and Table showed the comparison of physical activity and psychological distress of patients on hemodialysis. Patients with comorbidities who participated in moderate-intensity physical exercise had substantially reduced total BDI-II ($p = 0.04$) and BAI ($p = 0.03$). Nevertheless, the ratings for both tiredness intensity and fatigue interference were not substantially different based on the presence of comorbidities.

Table 5. Comparison of physical activity and psychological distress of patients on hemodialysis

	Physical activity below 600 MET-min/week	Physical activity Above 600 MET-min/week	P value
BDI-II	7.02	4.11	0.04
BAI	4.53	1.43	0.03
Fatigue severity	4.04	3.42	0.21
Fatigue interference	2.57	2.11	0.16

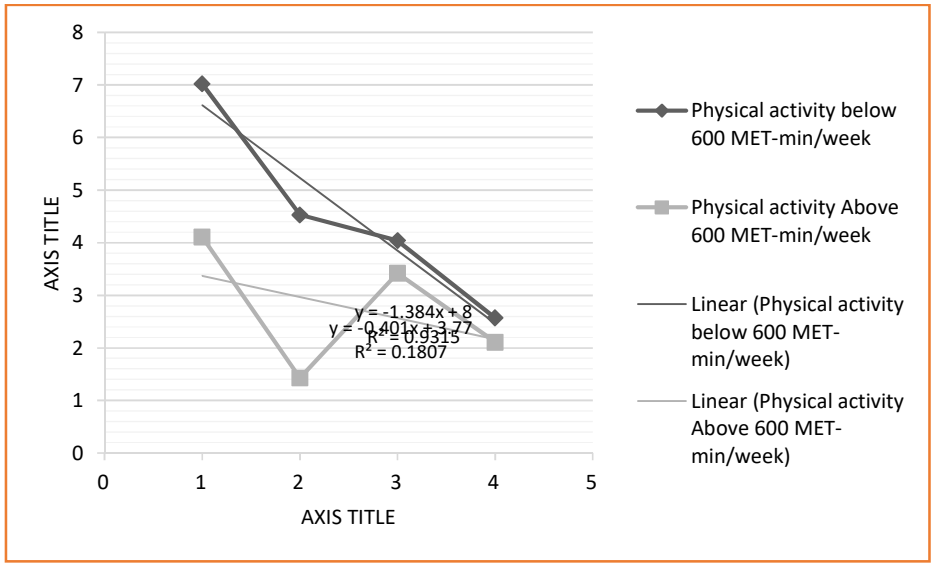

Fig 5. Comparison of physical activity and psychological distress of patients on hemodialysis

DISCUSSION

Among the patients of hemodialysis with the presence of comorbidities, there was apparent but statistical difference between those who participated in the action of moderate-intensity physical activities on a weekly basis and those who engaged in the activities of low-intensity physical activities on a weekly basis with regard to increase in depression, anxiety, fatigue severity and so on. Furthermore, it was clear that there were associations that existed between consistent physical activities and lower levels of both function severities and impact interference. The patients who took hemodialysis, placed into the group, which was doing moderate-intensity physical activities once a week reported very much less severity of low mood, anxiety, and fatigue, compared to the patients who were engaged in mild physical

activities once a week. Nevertheless, between the two groups, breakthrough no significant gap disclosed.

The results of our study show the existence of the clear relationship among the physical activity capabilities , depression severity, anxiety level, and tiredness level. In addition, frequently energetic activities are associated with the fatigue intensity as well. The key reason resulting to decrease in the body physical function in kidney patients under hemodialysis treatment increased due to lack of exercise and this led to an increased risk of morbidity. Combined with appropriate clinician advice physical exercise helps individuals with chronic kidney disease (CKD) and is not only a safe but also useful therapy in prevention of risk of complications and comorbidities caused by this condition. Therefore, the participation of people in activities through grooving and engaging in sports are a fundamental elements which are very helpful in preventing and curing diseases. "Exercise as medicine" advocates that exercise is contributing not only to improvement of body functions such as muscles [22]. Also increase the probability of success down the complicated path of chronic diseases advancement. The field sciences indicate that lack of physical activity is the reason most frequently linked to the physical function loss, exercise capacity decrease, and muscular dystrophy appearance [21]. Comorbidities and diseases are closely intertwined and their interplay has a cardinal effect on the functional status and longevity of a patient. Similarly, diseases take a worse form because of the presence of comorbidity; comorbidity worsens the dynamicity of the disease. A significant part of the patients' recovery and state of well-being is physical exercise as the strongest tool. Scientists have evidenced that joining active workouts with moderate intensity can be a great way of a heart coronary disease and also developing type 2 diabetes. On the other hand, the observational research suggests that it plays a vital role in preventing death and decrease feelings of anxiety and sadness in hemodialysis patients [24]. Regular participation in a constant sporting activity gives about a long term health benefits, such as less chances of a disease, better performance at physical tasks and a slower decrease in physical abilities as one ocean. [25].

Current research revealed the causal relationship between the level of exercise treatment, that patients received, in comorbid conditions, and the severity of their depression, and anxiety. Remarkably, it was identified that this in engaged the middle intensity activities as having the significant effect to their comorbidities. The observed effects from these patients might be restricted to the presence of anxiety and depression which causing a reduction to their willingness to do exercises, especially the ones with comorbid health conditions. It initiates a circle which brings more and more physical inactivity, as a result, the

despair and fear of patients becomes l'a greater. Our preliminary research indicates the need for more researches in order to promote the psychological well-being of HD patients with comorbidities.

Patients having the condition need exercise in order to keep their pensiveness out of the emotion of Depression but hemodialysis diminishes the ability of them to follow any routine of exercise. This relationship is in part explained by the difficulties presented due to the alteration in the quality of life, and loss of roles as a result of the existence of chronic conditions [21]. The other crucial area to be addressed by the clinical care workers with patients' depressive state is physical exercise which should be deemed as part of the treatment, not only pharmacological. Physical exercise is helpful in curing mimic depression mania. We might obtain considerable result by integrating physical activity treatments to the hemodialysis therapy due to the reduction in depression in ESRD patients undergoing hemodialysis, which in turn will accomplish their illness progression [26]. Both exercise and running are known to activate most anti-depression neuroplastic cellular and molecular mechanisms at the central nervous system level. They reduce chronic inflammation, promote endorphins to handle stress well as well as increase self-confidence and self-esteem of the individuals [27]. Therapy modes, like cardiovascular endurance training, enhancing resilience, and muscle training, could serve as the relief or even cure for depression [28]. It means that implementation of physical exercise may be considered as a non-pharmaceutical measure to prevent these ailments in the course of hemodialysis, thereby lessening the emergence of such disorders and eventually the onset of other psychological disorders related to it. A study on people in Taiwan found comorbidity has such an enhancement on depression that, symptoms of depression still remain which are no better after sociodemographic characteristics as well as medical comorbidities were accounted for. This parallel with the outcome of the current study shows on what the previous studies have been focusing. [29,30].

Through the current study it is found that subjects undergoing hemodialysis, who participate in the physical activity of small magnitude, decrease their anxiety and distress levels. Thus, it is concordant with the findings that were published by Dziubeck et al. (2016) [16]. This comes as a result of challenges which either cause physical activity or require emotional/cognitive effort, thus leading to the reorganisation of the hippocampus, amygdala and prefrontal cortex [31]. Participation in physical exercise training programs, as a part of nonpharmacies method, has a potential to improve patient's mood while undergoing hemmodialysis, stimulate recovery progress as well as alter the way patients behave in the future. Regular exercising programs have proven beneficial in relieving anxiety symptoms in

people undergoing hemodialysis, and bring tangible results in terms of recovery of physical function [28]. Healthcare professionals should instruct this patient population to stress the importance of exercising and designing training programs that have the ability to decrease their anxiety by having a consistent physical exercise.

Through the study, which lasted for three weeks, each of the participants was given three 30-minute physical exercise appointments per week. Extremely close correlation was revealed between the grading of fatigue and the extent to which it hampered the patient's life activities for everyone receiving hemodialysis. Yet, a clear link between the degree of tiredness and fatigue distress were not noted among the hemodialysis patients with moderate-level works out regularly. This is where anemia could result from frequent hemolysis because all of the participants exhibit muscular exhaustion. Since of this reason, physical activity trial made just for hemodialysis patients should certainly instigate patients to do some low-intensity activities and then adjust the level of that activity according to patient's health status. The exhaustion syndrome more intensively affects hemodialysis patients than those on the list for transplantation or not receiving dialysis at all. Thus, there are no drugs currently being made or known that could prevent weariness or cure it effectively. It has been researched that the positive effects of physiologic functioning, including the hypothalamic-pituitary-adrenal axis, rise by purposely partaking in the activities of physical exercise. Also, the muscle catabolism is promoted. Hence, it can be said that it is a common occurrence for people who are being subjected to the procedure to get reasonably rested. Besides, those chronic renal failure patients going hemodialysis on weekly basis by taking other moderate-intensity exercise activities such as aerobic or endurance exercise consistently complain about reduction in medications side effects [32,33].

It is the Kt/V score that is the gold standard for assessment of hemodialysis success. Specifically, it measures the waste clearance during the dialysis. It actually serves as a powerful intervenous factor in the prevention of the hemodialysis diseases and mortality. A Kt/V value higher than the standard value means that patients may maintain stable physical state with maximum vitality, and also with normal blood volume and blood pressure after hemodialysis. Moreover, performance on this therapy should influence the quality of life positively. The research found a pretty strong connection between a higher mean Kt/V score and a lower depression score according to a statistical correlation value. Posteriorly, it was noticed that it also remarked an explicitly relation between oliguria and tiredness. Those patients that have other medical conditions together with hemodialysis frequently face the problem of fatigue. It turned out that people who worked out less than an hour per day were

more likely to be tired while those who exercised over one hour regularly, were the happiest in the group [34]. Hornik's et al. study [35] showed that the difference in comorbidities in patients on hemodialysis was significant when there were always enough and the intensity of exercise was high against those whose physical activity was very low, sporadic. The author insists that exercise reduces the mortality rates among sufferers of a heart attack or stroke. The patients with hemodialysis who are constantly seized with illnesses need rapid management process to avoid health aggravation and medical conditions. Performing 30 minutes of exercise of moderate to high-intensity levels a day or for 150 minutes every week has been proved by scientific means that the patients undergoing hemodialysis will experience an increase in their muscle strength, energy level, self-care abilities, and Kt/V parameters. This reveals us that there is an enhanced level of efficiency in hemodialysis that comes about when the exercises are included and is also in support of the results of the current study[36].

What research reveals is that both college students and young professionals, when tired, may be more likely to select certain foods based on factors such as age and gender dimensions and may want to eat more when affected by cognitive processes and feeling anxiety or depression. Patients who may share some factors like age bracket (elderly), female gender, long-term illness, cognitive impairments, and symptoms of tiredness, anxiety, and depression are a group of them who experience constant fatigue. [37].

Besides, the connection is observable between patients undergoing hemodialysis for a long duration and 3) anxiety, sadness, or exhaustion is common [38]. Also studies reveal that existence of depression in hemodialysis patients can be linked to family relationships, stable income, presence of other chronic diseases and not enough physical activities. Participants with a higher body mass index (BMI) and a greater rate of physical activity in life situations have a better education for more than 12 years, a stable income of money, female gender and employment [39]. Patients' activity status during hemodialysis time may be statistically estimated by indicating factors such as their level of education, the existence of hypertension or cardiovascular illnesses, the reason of their hemodialysis treatment, and their musculoskeletal situation [40]. The beneficiaries from the current research have not shown any considerable differences in the physical activities levels between the individuals from diverse sociodemographic factors like the age, gender, educational levels, weight, and BMI. As far as hemodialysis patients who watched exercise treatment, there were significant decreases of anxiety and depression seen compared to those who did not engage themselves along with the treatment. Patients, taking hemodialysis, who style of lifestyle was second to

physical exercises were noted to place higher rates of anxiety and depression. The study emphasizes that routine physical activity is crucial to keep stable in mental sphere dialysis patients. This discovery is quite compatible with the findings of the current trial[40].

The fact that the generalizability of our findings was weak falsifying hypothesis was blamed on the low sample size. Therefore, the succeeding studies ought to include participants from a wide variety of groups or established partnerships with numerous medical centers to help in increasing the validity and reliability of the report. Additionally, the aforementioned research methodology for the current study did not enable the determination of the causes. But it gives new scientific knowledges about the links between individuals who wound up doing hemodialysis, comorbidities, slimming or gaining weight, sadness, anxiety, or willingness disorders. Besides that, a psychological stress (an example is sleep problems) could not be encompassed within the scope of this current investigation. Future action is to update the content of the questionnaire as well as assess physical activity in order to gain more exact knowledge on the connection between physical activity and the stimulation of the unpleasant feelings among the patients of hemodialysis having comorbidities.

The importance of an early treatment for patients doing hemodialysis who include a weekly training program of effort physical activities should be investigated by preceding research. The research should focus on the performance of these weekly programs (effort physical activities) that can be related after a completion period of time among many patients. These interventions are expected to reduce or completely eliminate the seriousness of the disease being interfered with and also eradicate the discomfort of physical existence owing to the disease. The current study is one to offer the first evidence that patients undergoing hemodialysis with comorbidities are in a better position to benefit from weekly physical activity training sessions of a moderate intensity which in turn improves the physical wellness. Although the process of aging is spontaneous, patients undergoing this process might have difficulties in doing the daily activities that demand a lot of energy. They may lose their interest in enjoying physical activities, for instance. As a result, the tendency of them having higher level of depression and anxiety is rising. Unlike us sedentary beings, physical exercise regularly wields off stress, sorrow, and irritation onus, resulting to an overall physical and mental wellness.

CONCLUSION

The results of this research suggest that people would relieve self-doubt, anxiety, and exhaustion with the moderate level exercise. The relationship between the moderate-intensity

physical exercise and sadness, anxiety or exhaustion might be considered as a model on which health care providers could tailor specific methods of the treatment of hemodialysis patients with many health conditions. Finally our study gives an understanding of what should be included in a therapy of this kind so as stress, emotional problems and depression could be eradicated from the life of such patients..

FUNDING STATEMENT

National Natural Science Foundation of China (81873245)

REFERENCES

1. Wen, J., Fang, Y., Su, Z. et al. Mental health and its influencing factors of maintenance hemodialysis patients: a semi-structured interview study. BMC Psychol.2023;11:84. https://doi.org/10.1186/s40359-023-01109-2
2. Elhadad, A.A., Ragab, A.Z.E. & Atia, S.A.A. Psychiatric comorbidity and quality of life in patients undergoing hemodialysis. Middle East Curr Psychiatry.2020; 27:9. https://doi.org/10.1186/s43045-020-0018-3.
3. Od B, Aydin E, Keyvan A, Ms Y, Tuna O, Devrimci Ozguven H Psychiatric comorbidity, sexual dysfunction, and quality of life in patients undergoing hemodialysis: a case-control study. Noro Psikiyatr Ars. 2017;54(2):137–142.
4. Shimoda T, Matsuzawa R, Yoneki K, Harada M, Watanabe T, Matsumoto M, et al. Changes in physical activity and risk of all-cause mortality in patients on maintence hemodialysis: a retrospective cohort study. BMC Nephrol. 2017;18(1):154.
5. Yamamoto S, Matsuzawa R, Hoshi K, Harada M, Watanabe T, Suzuki Y, et al. Impact of physical activity on dialysis and nondialysis days and clinical outcomes among patients on hemodialysis. J Ren Nutr. 2020;31:380–8.
6. Parthasarathi G., Narahari M.G., Gurudev K.C., Sathvik B.S. An assessment of the quality of life in hemodialysis patients using the WHOQOL-BREF questionnaire. *Indian J. Nephrol.* 2008;18:141–149. doi: 10.4103/0971-4065.45288.
7. Kraus M.A., Fluck R.J., Weinhandl E.D., Kansal S., Copland M., Komenda P., Finkelstein F.O. Intensive Hemodialysis and Health-Related Quality of Life. *Am. J. Kidney Dis.* 2016;68:S33–S42. doi: 10.1053/j.ajkd.2016.05.023.
8. Dembowska E, Jaroń A, Gabrysz-Trybek E, Bladowska J, Gacek S, Trybek G. Quality of Life in Patients with End-Stage Renal Disease Undergoing Hemodialysis. J Clin Med. 2022 Mar 13;11(6):1584. doi: 10.3390/jcm11061584. PMID: 35329910; PMCID: PMC8949549.
9. Wu YH, Hsu YJ, Tzeng WC. Correlation between Physical Activity and Psychological Distress in Patients Receiving Hemodialysis with Comorbidities: A Cross-Sectional Study. Int J Environ Res Public Health. 2022 Mar 26;19(7):3972. doi: 10.3390/ijerph19073972. PMID: 35409654; PMCID: PMC8997862.
10. Wu Y-H, Hsu Y-J, Tzeng W-C. Correlation between Physical Activity and Psychological Distress in Patients Receiving Hemodialysis with Comorbidities: A Cross-Sectional Study. *International Journal of Environmental Research and Public Health*. 2022; 19(7):3972. https://doi.org/10.3390/ijerph19073972

11. Matsunaga, Y., Suzuki, Y., Yamamoto, S. *et al.* Interactional effects of depressive symptoms and physical function on daily physical activity in ambulatory patients receiving hemodialysis. *Ren Replace Ther* **9**, 28 (2023). https://doi.org/10.1186/s41100-023-00485-0
12. Alshammari, B., Alkubati, S. A., Alrasheeday, A., Pasay-An, E., Edison, J. S., Madkhali, N., Alshammari, F. Factors influencing fatigue among patients undergoing hemodialysis: a multicenter cross-sectional study. Libyan Journal of Medicine. 2024; 19(1). https://doi.org/10.1080/19932820.2023.2301142
13. Watanabe T, Kutsuna T, Suzuki Y, Harada M, Shimoda T, Yamamoto S, et al. Perceived difficulty in activities of daily living and survival in patients receiving maintenance hemodialysis. Int Urol Nephrol. 2020;53:177–84
14. Yamamoto S, Matsuzawa R, Hoshi K, Harada M, Watanabe T, Suzuki Y, et al. Impact of physical activity on dialysis and nondialysis days and clinical outcomes among patients on hemodialysis. J Ren Nutr. 2020;31:380–8.
15. Kim, J.C.; Young Do, J.; Kang, S.H. Comparisons of physical activity and understanding of the importance of exercise accordingto dialysis modality in maintenance dialysis patients. *Sci. Rep.* **2021**, *11*, 21487.
16. Charlson, M.E.; Pompei, P.; Ales, K.L.; MacKenzie, C.R. A new method of classifying prognostic comorbidity in longitudinalstudies: Development and validation. *J. Chronic Dis.* **1987**, *40*, 373–383.
17. Bjordal, K.; de Graeff, A.; Fayers, P.M. A 12 country field study of the EORTC QLQ-C30 (version 3.0) and the head and neck cancer specific module (EORTC QLQ-H&N35) in head and neck patients. EORTC Quality of Life Group. *Eur. J. Cancer* **2000**,*36*, 1796–1807.
18. Chen, H. *Manual for the Beck Depression Inventory-II: The Chinese Version*; Chinese Behavioral Science Corporation: Taipei, Taiwan, 2000.
19. Lin, Y.J. *Manual for the Beck Anxiety Inventory*; Chinese Behavioral Science Corporation: Taipei, Taiwan, 2000
20. Chou, H.L.; Hsieh, P.C.; Yao, C.T.; Barsevick, A.M. Validity and Reliability of the Taiwanese Version of the General Fatigue Scalein Cancer Patients. *Cancer Nurs.* **2016**, *39*, 495–501
21. Painter, P.; Clark, L.; Olausson, J. Physical function and physical activity assessment and promotion in the hemodialysis clinic: Aqualitative study. *Am. J. Kidney Dis.* **2014**, *64*, 425–433
22. Wilkinson, T.J.; Shur, N.F.; Smith, A.C. “Exercise as medicine” in chronic kidney disease. *Scand. J. Med. Sci. Sports* **2016**,*26*, 985–988.
23. Moisoglou, I.; Margariti, E.; Kollia, K.; Droulias, J.; Savva, L. The role of demographic characteristics and comorbidities in hemodialysis patients’ health-related quality of life. *Hippokratia* **2017**, *21*, 163–168.
24. Bull, F.C.; Al-Ansari, S.S.; Biddle, S. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *Br.J. Sports Med.* **2020**, *54*, 1451–1462.
25. Blair, S.N. Physical inactivity: The biggest public health problem of the 21st century. *Br. J. Sports Med.* **2009**, *43*, 1–2.
26. Lin, C.H.; Hsu, Y.J.; Hsu, P.H. Effects of Intradialytic Exercise on Dialytic Parameters, Health-Related Quality of Life, and Depression Status in Hemodialysis Patients: A Randomized Controlled Trial. *Int. J. Environ. Res. Public Health* **2021**, *18*, 9205. [CrossRef] [PubMed]
27. Kandola, A.; Ashdown-Franks, G.; Hendrikse, J.; Sabiston, C.M.; Stubbs, B. Physical activity and depression: Towards under- standing the antidepressant mechanisms of physical activity. *Neurosci. Biobehav. Rev.* **2019**, *107*, 525–539. [CrossRef]

28. Roeh, A.; Kirchner, S.K.; Malchow, B. Depression in Somatic Disorders: Is There a Beneficial Effect of Exercise? *Front. Psychiatry* **2019**, *10*, 141. [CrossRef]
29. Frih, B.; Jaafar, H.; Mkacher, W.; Ben Salah, Z.; Hammami, M.; Frih, A. The Effect of Interdialytic Combined Resistance and Aerobic Exercise Training on Health Related Outcomes in Chronic Hemodialysis Patients: The Tunisian Randomized Controlled Study. *Front. Physiol.* **2017**, *8*, 288. [CrossRef]
30. Chiang, L.C.; Chiang, S.L.; Tzeng, W.C.; Lee, M.S.; Hung, Y.J.; Lin, C.H. Active Physical Activity Patterns Are Associated With Improved Quality of Life and Depression Status in Taiwanese Women with Metabolic Syndrome. *J. Cardiovasc. Nurs.* **2019**, *34*, 491–502. [CrossRef]
31. McEwen, B.S. Physiology and neurobiology of stress and adaptation: Central role of the brain. *Physiol. Rev.* **2007**, *87*, 873–904. [CrossRef]
32. Serdà, I.; Ferrer, B.C.; van Roekel, E.; Lynch, B.M. The Role of Physical Activity in Managing Fatigue in Cancer Survivors. *Curr. Nutr. Rep.* **2018**, *7*, 59–69. [CrossRef]
33. Oberoi, S.; Robinson, P.D.; Cataudella, D. Physical activity reduces fatigue in patients with cancer and hematopoietic stem cell transplant recipients: A systematic review and meta-analysis of randomized trials. *Crit. Rev. Oncol. Hematol.* **2018**, *122*, 52–59.[CrossRef] [PubMed]
34. Wang, S.Y.; Zang, X.Y.; Fu, S.H. Factors related to fatigue in Chinese patients with end-stage renal disease receiving maintenance hemodialysis: A multi-center cross-sectional study. *Ren. Fail.* **2016**, *38*, 442–450. [CrossRef] [PubMed]
35. Hornik, B.; Duława, J. Frailty, Quality of Life, Anxiety, and Other Factors Affecting Adherence to Physical Activity Recommenda-tions by Hemodialysis Patients. *Int. J. Environ. Res. Public Health* **2019**, *16*, 1827. [CrossRef]
36. Wang, I.K.; Tsai, M.K.; Liang, C.C. The role of physical activity in chronic kidney disease in the presence of diabetes mellitus: A prospective cohort study. *Am. J. Nephrol.* **2013**, *38*, 509–516. [CrossRef]
37. Siciliano, M.; Trojano, L.; Santangelo, G.; De Micco, R.; Tedeschi, G.; Tessitore, A. Fatigue in Parkinson's disease: A systematic review and meta-analysis. *Mov. Disord.* **2018**, *33*, 1712–1723. [CrossRef]
38. Bossola, M.; Di Stasio, E.; Monteburini, T. Intensity, Duration, and Frequency of Post-Dialysis Fatigue in Patients on Chronic Haemodialysis. *J. Ren. Care* **2020**, *46*, 115–123. [CrossRef] [PubMed]
39. Lin, C.H.; Chiang, S.L.; Yates, P.; Tzeng, W.C.; Lee, M.S.; Chiang, L.C. Influence of Socioeconomic Status and Perceived Barriers on Physical Activity Among Taiwanese Middle-Aged and Older Women. *J. Cardiovasc. Nurs.* **2017**, *32*, 321–330. [CrossRef] [PubMed]
40. Rosa, C.S.; Bueno, D.R.; Souza, G.D. Factors associated with leisure-time physical activity among patients undergoing hemodialy-sis. *BMC Nephrol.* **2015**, *16*, 192. [CrossRef] [PubMed]
41. Blough, J.; Loprinzi, P.D. Experimentally investigating the joint effects of physical activity and sedentary behavior on depression and anxiety: A randomized controlled trial. *J. Affect Disord.* **2018**, *239*, 258–268. [CrossRef] [PubMed]

Corresponding Author:
Rong Zhu
Department of Nephrology, Longhua Hospital, Shanghai University of Traditional Chinese Medicine,chief physician，China
E-mail: zr197211@163.com