SJIF Impact Factor: 5.464

WORLD JOURNAL OF ADVANCE HEALTHCARE RESEARCH

ISSN: 2457-0400
Volume: 6.
Issue: 10.
Page N. 44-50
Year: 2022

Original Article www.wjahr.com

EFFECT OF HYDRATION ON METABOLIC AND PSYCHOLOGICAL OUTCOMES IN HEMODIALYSIS PATIENTS

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Received date: 11 August 2022 **Revised date:** 31 August 2022 **Accepted date:** 20 September 2022

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ABSTRACT

Introduction: Chronic kidney failure is one of the chronic diseases for which medical nutrition therapy is very important. **Objectives:** This study aims to analyze the relationship between hydration status and metabolic and psychosocial factors in hemodialysis patients. **Methods:** The study was planned with 282 patients on hemodialysis. Biochemical and anthropometric parameters were analyzed. A form was formed regarding socio-demographic characteristics like age, gender, anthropometric measurements, diet, and source of information about fluid restriction and dietary advice. IBM SPSS 22.0 version (IBM Corp., Armonk, NY, USA) software program for Windows was used to analyze statistically the data obtained from the research. **Results:** The degree and frequency of non-adherence are correlated negatively with age and interdialytic weight gain; the degree and frequency of fluid non-adherence are correlated positively with the right hand grip and diet fluid consumption, the frequency of diet and fluids non-adherence are correlated positively with the duration of hemodialysis and the degree of diet non-adherence are correlated negatively with The Center for Epidemiologic Studies Depression Scale score ($p<0.05$). The degree and frequency of non-adherence are correlated positively with creatinine; the degree and frequency of fluid non-adherence are correlated negatively with HDL cholesterol; the degree of fluid non-adherence is correlated negatively with total cholesterol ($p<0.05$). **Conclusion:** The diet therapy applied per the necessity of the disease causes a decrease in the patient's mortality and morbidity and an increase in the quality of life.

KEYWORDS: End-stage renal disease, hemodialysis, hydration, diet, depression.

INTRODUCTION

Although chronic kidney disease is a global public health problem, the prevalence of end-stage renal disease (ESRD) is 150 per million, and approximately 9-13% of patients on dialysis die within a year. The all-cause mortality rate in hemodialysis patients is 6.3–8.2 times higher than in the general population.[1]

Renal replacement therapies such as renal transplantation, peritoneal dialysis, and hemodialysis (HD) are necessary for end-stage renal disease patients to survive. Nevertheless, these treatments alone are insufficient to improve the patients' quality of life, and they must be supported by strict diet therapy.[2]

Hemodialysis patients encounter an extensive lifestyle change due to a complicated and challenging medical regimen. Self-care behavior includes dietary recommendations that include choosing foods with low sodium, potassium, and phosphorus, adequate-protein intake, limiting daily fluid intake, and medication and vascular access care. Non-compliance with dietary recommendations in treatment causes the accumulation of metabolic by-products in the circulatory system and reduces the benefit of the treatment, exacerbates the symptoms, and reduces the patient's quality of life. This may cause an increase the morbidity and mortality in patients with renal failure. It also places an additional burden on both the patient and the healthcare system.[3]

Patients with ESRD can successfully continue the management of the disease with lifestyle changes. However, patients' non-compliance with diet and fluid restrictions may cause the metabolic product and excessive fluid accumulation, increasing morbidity and mortality rates. Insufficient compliance with the medical

nutrition therapy required by kidney patients can reduce the effectiveness of medical therapy, increase the symptoms of the disease, reduce the quality of life of the patient, and cause harm to both the patient and the country's economy.[4]

If the patient is incompatible with fluid and diet, this leads to interdialytic weight gain (IDWG). Excessive IDWG requires greater volume removal during hemodialysis. Mortality risk increases if relative IDWG > 5.7%.[1]

However, the effect of hydration status on depression in chronic HD patients is limited.[5]

It has been observed that HD patients with depressive symptoms have a higher risk of cognitive impairment, are less dependent on fluid restriction, medication, and dialysis treatments, and have an increased risk of hospitalization.[6]

In ESRD patients, depression is associated with decreased adherence to dialysis, lower quality of life, more significant medical comorbidity, and reduced survival.[7]

Non-adherence to fluid restrictions is a common problem with serious health consequences for patients with end-stage renal disease. This study aimed to evaluate the relationship between hydration status and metabolic and psychosocial factors in hemodialysis patients.

MATERIALS AND METHODS

Study design and participants

The study was conducted with 282 patients at Baskent University Hemodialysis Center in Ankara, Turkey. Inclusion criteria for study participation were i) patients diagnosed with End-Stage Renal Disease, ii) On regular fewest once a week on hemodialysis for at least three months or more, iv) Age 19 years or older.

Exclusion criteria for study participation: i) patients who were unwilling to participate in the study. ii) Critically ill patients who cannot be able to communicate.

Ethical considerations

For this study, ethics committee approval was obtained. After the individuals were informed about the study, individuals who wanted to participate voluntarily were included, and an "Informed Volunteer Consent Form" was obtained from the individuals.

Biochemical parameters

Glucose, blood urea nitrogen (BUN), creatinine, sodium, potassium, phosphorus, total protein, albumin, C-Reactive protein (CRP), Urea reduction rate (URR), KtV, total cholesterol, triglyceride (TG), High-density lipoprotein cholesterol (HDL-C), Low-density lipoprotein cholesterol (LDL-C) parameters were analyzed.

Data collection

The data was collected in three different forms. The first form was regarding socio-demographic characteristics like age, gender, anthropometric measurements, diet, and source of information about fluid restriction and dietary advice. Mid-upper arm circumference (MUAC), Calf circumference (CC), body weight, height, left hand grip, right hand grip parameters were evaluated, and body mass index calculated. Details regarding comorbid diseases like diabetes and hypertension and the duration of dialysis also were included in the study. The second instrument was self-reported "The Dialysis Diet and Fluid Nonadherence Questionnaire" (QDDF). The scale examines non-compliance with diet and fluid restriction in hemodialysis patients regarding frequency and degree. Belgüzar KARA (2009) adapted the Dialysis Diet and Fluid Non-adherence Questionnaire and conducted its validity and reliability study.[8,9]

The third instrument was CES-Depression Scale (The Center for Epidemiologic Studies Depression Scale), which was developed by The American National Mental Health Institute. Though it has not been advised as a tool for individual diagnosis, it is a short self-report scale developed for screening purposes and widely used in scientific studies to assess depressive symptoms in the general population. The scale consists of 20 items and the items of the scale measure quartet Likert type. While high scores indicate a predisposition to a depressive state, low scores mean that there is no depressive state. It was adapted to Turkish by Tatar and Saltukoğlu in 2010.[10]

Statistical Analysis

IBM SPSS 22.0 version (IBM Corp., Armonk, NY, USA) software program for Windows was used to analyze the data obtained from the research. The confidence interval of 95% and $p < 0.05$ were considered statistically significant. Quantitative data were presented as arithmetic mean ± standard deviation and qualitative data as numbers (%). Spearman's correlation coefficient was used in univariate analysis to evaluate the association between non-adherence to fluid and dietary factors and other continuous variables. When the data showed normal distribution, a one-way analysis of variance test was used in independent groups.

RESULTS

The mean age of the patients was 59.8±15.59 years. It was determined that the patients had chronic kidney disease for an average of 11.8 ± 11.25 years and had undergone hemodialysis for 6.1 ± 6.48 years on average 2.8 ± 0.67 times a week (Table 1).

Table 1: Some characteristics of the participants.

	Women		Men		Total	
	n:98		n:185		n:283	
	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD
Age (years)	60.3	15.05	59.5	15.89	59.8	15.59
Duration of kidney disease (years)	11.2	9.57	12.1	12.08	11.8	11.25
Duration of hemodialysis period (years)	5.95	6.26	6.17	6.61	6.1	6.48
Frequency of hemodialysis (day/week)	2.7	0.54	2.8	0.73	2.8	0.67

Considering the frequency of non-compliance in the last 14 days, diet non-adherence was found to be 3.5±4.81 days and fluid non-adherence 3.9 ±4.79 days (Table 2).

Table 2: The frequency of diet and of fluid non-adherence.

	$\overline{X}$	SS
Frequency of diet non-adherence	3.5	4.81
Frequency of fluids non-adherence	3.9	4.79

Considering the degree of incompliance with the diet, it was found that there was no non-adherence in 33.7% of the patients and varying degrees of diet non-adherence, from mild to very severe in 66.3% of the patients. Considering the degree of incompatibility with fluid restriction, it was determined that 48.0% of the patients had no non-adherence, and 52.0% of the patients had fluid non-adherence of varying degrees from mild to very severe (Figure 1).

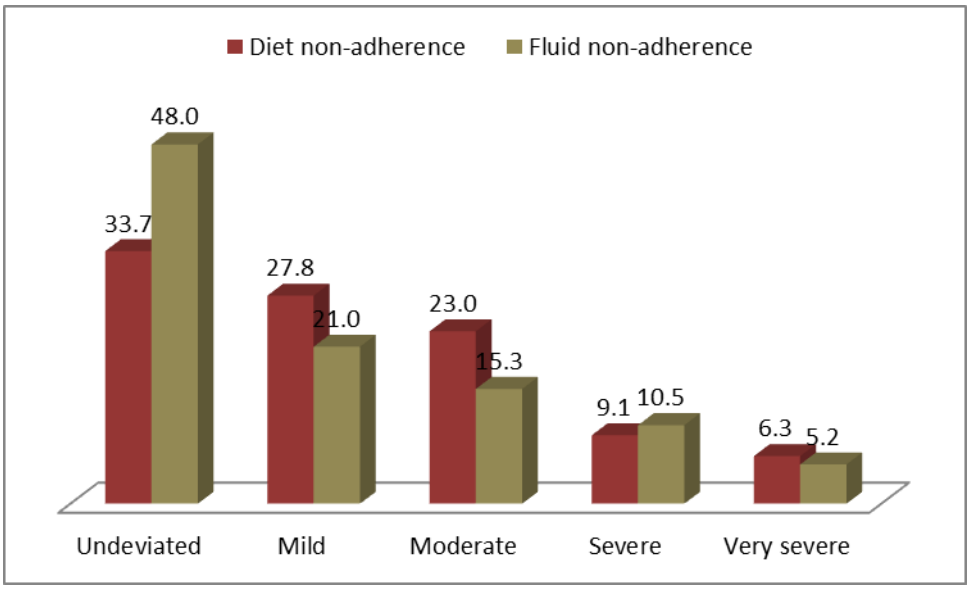

Figure 1: The degree of fluids and diet non-adherence in hemodialysis patient.

The degree and frequency of non-adherence are correlated negatively with age, IDWG; the degree and frequency of fluids non-adherence are correlated positively with right hand grip and diet fluid consumption; the frequency of diet and fluids non-adherence are correlated positively with duration of HD; the degree of diet non-adherence are correlated negatively with CES score ($p<0.05$) (Table 3).

Table 3: The correlation between non-adherence variables and some anthopometric and health-releated parameters.

	Day frequency of diet non-adherence		Degree of diet non-adherence		Day frequency of fluids non-adherence		Degree of fluids non-adherence	
	r	p	r	p	r	p	r	p
Age (years)	-0.167	0.008*	-0.153	0.015*	-0.215	0.001*	-0.238	0.000*
Inter-dialytic weight gain (kg)	0.246	0.000*	0.245	0.000*	0.392	0.000*	0.459	0.000*
BMI (kg/m^2)	-0.058	0.363	-0.062	0.329	0.041	0.519	-0.015	0.815
MUAC (cm)	0.045	0.477	0.029	0.647	0.045	0.485	0.053	0.407
CC (cm)	0.078	0.220	0.062	0.330	0.046	0.474	0.050	0.433
Right hand cript	0.055	0.433	0.070	0.322	0.153	0.031*	0.231	0.001*
Left hand cript	-0.145	0.121	-0.093	0.323	0.019	0.839	0.002	0.981
Duration of CKD (years)	0.042	0.503	0.027	0.666	-0.025	0.698	-0.053	0.406
Duration of HD (years)	0.204	0.001*	0.113	0.073	0.131	0.040*	0.049	0.439
Fluid consumption (mL)	0.074	0.242	0.094	0.136	0.179	0.005*	0.206	0.001*
Urine amount (mL)	0.007	0.939	-0.010	0.907	-0.046	0.593	-0.122	0.154
CES-D	0.024	0.705	-0.141	0.026*	0.084	0.186	0.028	0.663

**p<0.05*

MUAC: mid-upper arm circumference, CC: Calf circumference, CKD: Chronic kidney disease, CES-D: The Center for Epidemiologic Studies Depression Scale

The degree and frequency of non-adherence are correlated positively with creatinine; the degree and frequency of fluid non-adherence are correlated negatively with HDL-cholesterol; the degree of fluid non-adherence is correlated negatively with total cholesterol ($p<0.05$) (Table 4).

Table 4: The correlation between non-adherence variables and some biochemical parameters.

	Day frequency of diet non-adherence		Degree of diet non-adherence		Day frequency of fluids non-adherence		Degree of fluids non-adherence	
	r	p	r	p	r	p	r	p
Glucose (mg/dL)	-0.021	0.737	-0.019	0.760	-0.013	0.841	0.021	0.749
BUN (mg/dL)	0.071	0.265	0.095	0.136	0.083	0.193	0.088	0.171
Creatinin (mg/dL)	0.170*	0.007	0.184*	0.004	0.126*	0.047	0.174*	0.006
Sodium (mmol/L)	-0.060	0.347	-0.063	0.321	-0.055	0.392	-0.062	0.337
Potassium (mmol/L)	-0.053	0.408	-0.021	0.746	0.011	0.860	0.056	0.384
Phosphorus (mg/dL)	0.090	0.156	0.103	0.105	0.045	0.478	0.076	0.236
Total protein (g/dL)	-0.036	0.570	-0.075	0.240	0.013	0.837	-0.009	0.892
Albumin (g/dL)	0.002	0.976	0.042	0.510	0.062	0.335	0.053	0.410
CRP (mg/dL)	-0.026	0.683	-0.036	0.579	-0.083	0.204	-0.094	0.147
URR	-0.041	0.523	-0.098	0.127	-0.071	0.273	-0.112	0.082
Kt/V	-0.074	0.248	-0.095	0.138	-0.067	0.298	-0.078	0.227
Total cholesterol (mg/dL)	-0.086	0.190	-0.074	0.262	-0.027	0.680	-0.143*	0.030
TG (mg/dL)	0.046	0.489	0.001	0.987	0.106	0.110	0.079	0.229
HDL-C (mg/dL)	-0.047	0.477	-0.044	0.503	-0.156*	0.018	-0.196*	0.003
LDL-C (mg/dL)	-0.023	0.727	-0.009	0.890	0.044	0.509	-0.052	0.430

**p<0.05*

BUN: Blood Urea Nitrogen, CRP: C-Reactive Protein, URR: Urea Reduction Rate, TG: Triglycerid, HDL-C: High Density Lipoprotein Triglycerid, LDL-C: Low Density Lipoprotein Triglycerid

To the degree of diet and fluid non-adherence, the mean CES-D scores of patients who were in the undeviated group (respectively; 18.2±11.28 and 14.8±9.58) and the mean CES-D scores of patients who were severe group (respectively; 18.3±12.21 and 14.1±12.94) were found to be similar. With varying degrees of diet non-adherence, from mild to very severe, the highest score of CES-D in a very severe group (18.3±12.21) ($p<0.05$). Also, it was determined that the CES-D scores of patients in the severe group were the highest according to the degree of fluid non-adherence ($p<0.05$) (Table 5).

Table 5: The hemodialysis patients' CES-D scores according to the degree of fluids and diet non-adherence.

	CES-D		
	$\overline{X}$	SD	p
Degree of diet non-adherence			
Undeviated	18.2	11.28	0.004*
Mild	14.8	10.99	
Moderate	12.4	9.36	
Severe	11.2	6.80	
Very severe	18.3	12.21	
Degree of fluid non-adherence			
Undeviated	14.8	9.58	0.082
Mild	16.7	12.91	
Moderate	15.7	9.62	
Severe	16.6	12.18	
Very severe	14.1	12.94	

**p<0.05*

DISCUSSION

The present study was conducted to describe the effect of hydration in patients with maintenance hemodialysis and determine the association with some metabolic and psychological variables. Compliance with diet, fluid restriction, and treatment can reduce mortality, severe comorbidities and enhance general health and well-being in patients on hemodialysis.[11,12]

The percentage of patients on dialysis who do not adhere to their dietary and therapeutic regimens ranges from 25% to 86%.[13]

A study found a prevalence rate of 15.3% for non-adherence to fluid restriction, 26.9% for dietary restriction, and 21.2% for HD sessions.[14]

Our study determined that 48.0% of the patients had no non-adherence, and 52.0% had fluid non-adherence of varying degrees from mild to very severe. The dialysis diet and fluid non-adherence questionnaire is a self-report instrument for clinical practice. This may, therefore, overestimate. However, our prevalence rate is comparable to similar studies.[15]

Safdar et al. reported a high prevalence (64%) of non-adherence to fluid restriction among hemodialysis patients undergoing two-day/week. In our study, patients undergoing hemodialysis an average of 2.8±0.67 times a week may reduce the rate of non-compliance.[16]

Higher IDWG is strongly associated with mortality and can reduce the effectiveness of the treatment and cause disease progression and many complications.[17]

Compliance with fluid and dietary restrictions is one of the most critical factors affecting IDWG. An observational study detected poor dietary and fluid adherence in individuals with IDWG of more than 2 kg.[18]

Barnett et al.[19] performed an exploratory study. They identified that the 26 patients who were non-compliant with diet and fluid restrictions had an inter-dialytic weight gain of more than 2.5 kg. In this study, the degree and frequency of non-adherence are correlated negatively with IDWG ($p<0.05$).

It has been reported that worsening nutritional status is associated with a longer dialysis period. The resulting malnutrition directly affects the prognoses of dialysis patients, increases dialysis-associated mortality rates, and lowers the quality of life.[20]

In this study, the frequency of diet and fluids non-adherence are correlated positively with the duration of HD ($p<0.05$). Unfortunately, in diseases such as end-stage renal disease that require a lifelong diet, loss of motivation can be seen in this process. Mailani and Bakri also showed that the longer the hemodialysis, the lower the fluid restriction compliance in their study.[21]

In patients with end-stage renal disease, the glomerular filtration rate is below 15 ml/min/1.73 m^2, and metabolic waste products are insufficiently excreted from the body. Therefore, if patients do not comply with dietary regulations, biochemical parameters can be adversely affected.[22]

Jampour et al.[23] determined that in the non-adherent groups, phosphorus and serum albumin levels were higher than those those who adhered to their diet. This study likewise, in our study, the results were similar. It is thought that this situation may have arisen due to not applying low phosphorus and protein diets, which hemodialysis patients may require.

Inter-dialytic weight gain, serum phosphorus, and depression scores were significantly higher in non-compliant patients than in compliant patients. In contrast, body weight, serum albumin, serum calcium, quality of life scores, and nutrition scores were significantly higher in compliant patients (P <0.05).[24]

Managing hyperphosphatemia in patients with late-stage chronic kidney disease requires an individualized approach involving a combination of adequate dietary advice, phosphate-binder use, and adjustments to dialysis prescription.[25]

A study found a prevalence of 26.9% for non-adherence to dietary restriction, which is in line with rates reported for most studies that used serum phosphorus as a surrogate for non-adherence to dietary restriction. Studies that have used serum potassium alone or combined with serum phosphorus have found rates ranging from 5.5% to 52%.[26]

In a study in which most of the individuals participating in the study did not comply with fluid restriction (56%), it was determined that the serum phosphorus, potassium, and blood urea nitrogen levels were higher than expected levels.[27]

This study showed that as the serum phosphorus value increases, the non-adherence variables increase.

In a systematic review, it was determined that depressive symptoms increase diet non-compliance. Depressive symptoms and dietary non-adherence were highly prevalent in hemodialysis patients. The prevalence of depressive symptoms and dietary non-adherence ranged from 6–83.49% and 41.1–98.3%, respectively.[28]

In another study investigating the relationship of depression with poor diet and fluid restriction compliance in hemodialysis patients, depressive symptoms and their severity positively correlated with poor compliance. The number of patients with the adequacy of dialysis, depressive symptoms, anxiety symptoms, poor compliance with fluid restriction, and dietary selection were respectively 50 (62.5%), 54 (61.4%), 46 (52.3%), 47 (53.4%) and 31 (35.2%).[29]

There is a statistically insignificant but similar result to the literature in our study. The highest score of CES-D in the very severe group was (18.3±12.21) ($p<0.05$). It was determined that the CES-D scores of patients in the severe group were the highest according to the degree of fluid non-adherence ($p<0.05$). In patients with chronic renal failure, it is known that many mental and social problems accompany these disorders. Depression, which is common in dialysis patients, and the decrease in quality of life associated with it are important because of its adverse effects on adherence to treatment and the prognosis of the disease. These problems also affect the existing disease by affecting the diet compliance of the patients in our study.

CONCLUSION

Medical nutrition therapy has an important place in the management of end-stage renal disease and the regimen of many chronic diseases. The diet therapy applied in accordance with the necessity of the disease causes a decrease in the mortality and morbidity of the patients and an increase in the quality of life. So alternative measures have to identify to improve the fluid and diet compliance behavior due to its high risk of morbidity and mortality, as it is one of the most challenging tasks.

Limitations

It must be noted that the assessment of diet and fluid adherence was done by a self-reported instrument. The incapable number of samples can also be a limiting factor.

Funding: This study was approved by Baskent University Institutional Review Board (Project no: KA20/177) and supported by Baskent University Research Fund.

Conflict of interest: The authors declared no potential conflicts of interest concerning this article's research, authorship, and/or publication.

Ethical considerations

This study was approved by Başkent University Medical and Health Sciences Research Board (Project no: KA19/369). After the individuals were informed about the study, individuals who wanted to participate in the study voluntarily were included and "Informed Volunteer Consent Form" was obtained from the individuals.

Author Contributions

Esra Köseler Beyaz: Conceptualization, Methodology, Data curation, Writing- Original draft preparation, Writing- Reviewing and Editing, **Perim Fatma Türker:** Conceptualization, Methodology, Data curation, Writing- Original draft preparation, Writing- Reviewing and Editing. **Gül Kızıltan:** Conceptualization, Methodology, Data curation, Writing- Original draft preparation, Reviewing and Editing, **Mendane Saka:** Conceptualization, Methodology, Data curation, Writing- Original draft preparation, Reviewing and Editing**.**

Transparency Declaration

The authors affirms that this manuscript is an honest,accurate and transparent account of the study being reported

ACKNOWLEDGMENTS

We special thank the all patients and staff in Baskent University Hemodialysis Center in Ankara, Turkey.

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