North Clin Istanb 2023;10(4):435–443
doi: 10.14744/nci.2023.01799

Original Article NEPHROLOGY

Relationship between symptom burden and dialysis adequacy in patients with chronic kidney disease undergoing hemodialysis

Tahsin Karaaslan,[1] Irem Pembegul[2]

[1]Department of Nephrology, Hypertension, and Kidney Transplantation, Medeniyet University Faculty of Medicine, Goztepe Prof. Dr. Suleyman Yalcin City Hospital, Istanbul, Turkiye

[2]Department of Nephrology, Hypertension, and Kidney Transplantation, Turgut Ozal University Faculty of Medicine, Malatya Training and Research Hospital, Malatya, Turkiye

ABSTRACT

OBJECTIVE: The aim of this study was to reveal the relationship between hemodialysis (HD) adequacy and dialysis symptom index (DSI) in patients with end-stage kidney disease (ESKD).

METHODS: This prospective study included 92 ESKD patients who underwent HD three times a week. Data including sex, age, education status, marital status, economic status, employment status, dependency status, type of vascular access, and duration of HD were recorded. Biochemical and hematological analyses were carried out. Dialysis adequacy was assessed based on clinical and biochemical analysis. The DSI was used to evaluate the emotional and physical symptoms of HD patients.

RESULTS: Of the patients, 55 were males and 37 were females, with a mean age of 59.95±14.9 years. The median duration of HD was 60.0 months (interquartile range: 20.8–103.5). The mean DSI score was 54.35±26.0, with a significantly higher score in female patients ($p<0.001$). There was a significant correlation between DSI and increasing age ($p<0.05$). The single pool Kt/V (spKt/V) ratio of HD patients with AVF access was significantly higher, and the mean DSI was significantly lower than that of those receiving HD with a central venous catheter ($p<0.001$). The mean DSI score was significantly higher in patients with a spKt/V ratio of <1.2 than those with a spKt/V ratio of ≥1.2 ($p<0.001$). In multivariate regression analysis using biochemical parameters, the spKt/V ratio was a significant and independent predictor of DSI scores ($R^2=0.64$, $p<0.001$). In addition, a significant and independent relationship was found between DSI and gender, age, and economic status in the regression analysis ($R^2=0.36$, $p<0.001$).

CONCLUSION: Dialysis adequacy is an independent predictor of DSI. If an adequate dialysis dose is ensured to be delivered, symptom burden may dramatically decrease.

Keywords: Arteriovenous fistula; dialysis adequacy; dialysis symptom index; spKt/V; symptom burden.

Cite this article as: *Karaaslan T, Pembegul I. Relationship between symptom burden and dialysis adequacy in patients with chronic kidney disease undergoing hemodialysis. North Clin Istanb 2023;10(4):435–443.*

Chronic kidney disease (CKD) is a clinicopathological condition characterized by the presence of structural or functional kidney damage and an estimated glomerular filtration rate of <60 mL/min/.73 m^2 for ≥3 months [1]. The global incidence of CKD is 13.4%, with a prevalence of 10.6% in Stage 3–5 patients [2]. According to the 2021 Turkish Society of Nephrology data, 60,051 patients received renal replacement through hemodialysis (HD) by the end of 2021 [3].

Received: February 05, 2023 *Revised:* March 30, 2023 *Accepted:* April 24, 2023 *Online:* August 08, 2023

Correspondence: Tahsin KARAASLAN, MD. Medeniyet Universitesi Tip Fakultesi, Nefroloji, Hipertansiyon Bilim Dali ve Bobrek Nakli Unitesi, Goztepe Prof. Dr. Suleyman Yalcin Sehir Hastanesi, Istanbul, Turkiye.
Tel: +90 216 566 40 00 e-mail: drtkaraaslan@hotmail.com

Dialysis adequacy is defined as the assurance of the complete physical, mental, and biochemical well-being of the patient with improved quality of life (QoL) to reduce morbidity and mortality in patients undergoing HD [4]. It is mainly measured based on the evaluation of kinetic indicators as well as biochemical analysis. In clinical practice, the urea reduction ratio (URR) and the single pool Kt/V (spKt/V) mathematical construct are used to evaluate dialysis adequacy [5]. Several studies have shown that better HD is associated with less uremic complications, symptoms, morbidity, and mortality [6]. A spKt/V ratio of <1.2 is an indicator of increased mortality among HD patients [7]. Current clinical practice guidelines recommend keeping the spKt/V ratio within a target range of 1.2–1.4 per session for HD patients three times a week [8].

CKD is generally asymptomatic until advanced stages [9]. End-stage renal disease is typically characterized by fatigue, lethargy, itching, constipation, loss of appetite, nausea or vomiting, pain, dry mouth, muscle cramps, difficulty in concentration, sleep disorders, dyspnea, anxiety, and restless leg syndrome [10]. The severity of these symptoms varies from patient to patient. The increased physical and emotional burden of the disease may impair the QoL of HD patients [11]. Weisbord et al. [12] developed a 30-item dialysis symptom index (DSI) to assess the frequency and severity of symptoms in HD patients. Later, Onsoz et al. [13] conducted the validity and reliability studies of the DSI in the Turkish population. In the present study, we aimed to evaluate the relationship between DSI and HD adequacy in patients with CKD.

Highlight key points

- The mean total DSI score of female patients was significantly higher than those of male patient.
- In particular, the mean DSI score was significantly higher in the ≥65 age.
- In patients with adequate dialysis dose (spKt/V >1.2), the symptom burden is significantly reduced.
- A significant and independent relationship was found between DSI and gender, age, and economic status.
- Patients with severe symptoms need to have their dialysis dose reviewed.

MATERIALS AND METHODS

Study Design and Study Population

This descriptive, cross-sectional, prospective study was conducted at the Department of Nephrology, HD Unit, of a tertiary care center between November 1st, 2022, and December 10th, 2022. A total of 92 patients aged above 18 who underwent HD three times a week were included. Those having no cognitive function to understand and answer the questions correctly, having communication problems, and patients who were unwilling to participate in the study were excluded. Before the study, all patients were informed about the content of the study, and their written consent was obtained. The study was approved by the Malatya Training and Research Hospital Clinical Research Ethics Committee (no. 2022/178, date: 31/10/2022) and was conducted in accordance with the principles of the Declaration of Helsinki.

Data Collection

Data were collected by an HD nurse who was trained in the study through face-to-face interview technique. Data including age, sex, marital status, education status, employment status, family members living with the patient, economic status, dependency status, type of vascular access, the use of erythropoiesis-stimulating agents (ESAs), and duration of HD were recorded in the Patient Identification Form. In addition, biochemical and hematological analyses were carried out using pre- and post-HD blood samples from the patients. All patients were evaluated for comorbid diseases such as diabetes, hypertension, coronary heart disease, heart failure, and other chronic diseases.

Dialysis Adequacy

Dialysis adequacy was assessed based on clinical and biochemical analysis and the measurement of kinetic indicators. All patients were evaluated for physical and mental status, nutritional status, vital signs, volume status, uremic symptoms, physical activity status, acidosis, anemia, and metabolic bone disease. The urea kinetic model was also used to assess dialysis adequacy via the Daugirdas formula (DKt/V) and spKt/V ratio (K, dialyzer urea clearance; t, total dialysis session; V, volume of distribution of urea) [14]. An spKt/V ratio of ≥1.2 calculated using the values after one HD session was considered a significant criterion for dialysis adequacy:

spKt/V Daugirdas= -ln ([BUN_{Post}/BUN_{Pre}] - [0.008*hour]) + ([4-(3.5*BUN_{Post}/BUN_{Pre})]* UF_{Vol}/ Weight) [14].

Table 1. Descriptive characteristics of patients, comparison and correlation analysis between groups

	%	spKt/V Mean±SD	t/U	p	DSI Mean±SD		p
spKt/V							
Total	100	1.28±0.4			54.35±26.0	r=-0.76	<**0.001**
<1.2	40.2	0.92±0.1			78.27±12.5	t=12.01	<**0.001**
≥1.2	59.8	1.52±0.2			38.25±19.4		
Sex							
Total	100	1.28±0.4	rho=0.38	<**0.001**	54.35±26.0	rho=-0.43	<**0.001**
Female	40.2	1.11±0.3	U=558.0	<**0.001**	67.46±71.0[a]	U=502.0	<**0.001**
Male	59.8	1.39±0.3			45.53±42.0[a]		
Age							
Total	100	59.9±14.9	r=0.34	**0.001**	54.35±26.0	r=-0.35	**0.001**
18-49	26.1	1.42±0.4	F=10.1	**0.007**	45.58±25.0	F=7.85	**0.001**
50-64	33.7	1.35±0.3			46.58±25.2		
≥65	40.2	1.13±0.3			66.54±22.9		
Marital status			rho=0.18	0.093	54.35±26.0	rho=-0.2	0.140
Married	88.0	1.26±0.4	U=306.0	0.093	55.75±25.3	U=322.5	0.139
Single	12.0	1.46±0.4			44.00±29.6		
Educational status			rho=0.28	**0.006**	54.35±26.0	rho=-0.4	<**0.001**
Illiterate	45.7	1.16±0.3	H=11.06	**0.026**	66.71±21.1	H=20.4	<**0.001**
Literate	20.7	1.37±0.4			45.42±29.2		
Primary school	23.9	1.43±0.4			40.31±19.4		
Second school	8.7	1.30±0.3			47.13±31.5		
High school	1.1	1.01±0.0					
Employment status			rho=-0.4	<**0.001**	54.35±26.0	rho=0.31	**0.003**
Employed	12.0	1.63±0.1	U=131.5	<**0.001**	33.54±14.8	U=204.0	**0.004**
Unemployed	88.0	1.23±0.4			57.17±25.9		
Economic status			rho=0.30	**0.004**	54.35±26.0	rho=-0.4	<**0.001**
Poor	66.3	1.20±0.3	U=598.0	**0.004**	61.61±24.5	U=490.5	<**0.001**
Middle-good	33.7	1.44±0.3			40.06±23.0		
Family members living with the patient			rho=-0.1	0.350	54.35±26.0	rho=0.05	0.662
Alone	9.8	1.41±0.44	U=302.2	0.347	50.67±28.9	U=340.0	0.660
Wife&children	90.2	1.27±0.35			54.75±25.8		
Helping care			rho=0.30	**0.004**	54.35±26.0	rho=-0.4	<**0.001**
Available	69.6	1.21±0.3	U=557.5	**0.004**	60.62±25.0	t=3.75	<**0.001**
Absent	30.4	1.45±0.3			40.00±22.7		

U: Mann-Withney U; F: ANOVA; H: Kruskal-Wallis H; a: Median; DSI: Dialysis Symptom Index; CVD: Cardiovascular disease; SD: Standard deviation; AVF: Arteriovenous fistula; CVC: Central venous catheter; ESA: Erythropoiesis stimulating agent. Pearson correlation, independent-student T, Mann-whitney U and oneway ANOVA tests were used in this table.

DSI

The DSI was developed by Weisbord et al. [12] to evaluate the emotional and physical symptoms of HD patients. It is a 30-item, self-reported index that is answered "Yes" or "No" regarding the symptoms during the past week. Using a 5-point Likert scale, 0=not at all, 1=a little bit, 2=somewhat, 3=quite a bit, and 4=very much. The total score is calculated by summing each symptom severity score ranging from 0 to 120, where 0 indicates no symptom burden and 120 indicates the most severe symptom burden. In 2013, the validity and reliability studies of the DSI were carried out by Onsoz et al. [13] in the Turkish population.

Table 2. Relationship between comorbidity, length of stay on dialysis and DSIs

	%	spKt/V Mean±SD	r	p	DSI Mean±SD	r	p
Comorbidity		1.28±0.4	rho=0.17	0.106	54.35±26.0	rho=-0.2	0.104
HT	45.7	1.24±0.4	H=4.42	0.110	59.02±26.6	H=2.80	0.246
DM	43.5	1.28±0.3			50.27±26.7		
CVD	10.9	1.47±0.3			51.00±26.0		
Residence time on dialysis (month)							
Total	100	1.28±0.4	rho=0.16	0.133	54.35±26.0	rho=-0.09	0.389
1–12	15.2	1.28±0.3	H=1.47	0.479	53.07±29.8	H=1.33	0.514
13-60	35.9	1.22±0.3			58.39±25.9		
>61	48.9	1.32±0.4			51.78±25.1		
Type of vascular access		1.28±0.4	r=-3.34	**0.001**	54.35±26.0	r=0.37	<**0.001**
AVF	64.1	1.37±0.4	t=3.40	**0.001**	47.25±24.9	t=-3.74	<**0.001**
CVC	35.9	1.12±0.3			67.03±23.2		
ESA use		1.28±0.4	rho=0.39	<**0.001**	54.35±26.0	rho=-0.41	<**0.001**
Use	55.4	1.17±0.4	U=572.5	<**0.001**	63.62±26.1	U=546.5	<**0.001**
Not use	44.6	1.42±0.3			42.80±21.0		

U: Mann-Withney U; H: Kruskal-Wallis H. DSIs: Dialysis Symptom Index score; SD: Standard deviation; ESA: Erythropoiesis stimulating agent; HT: Hypertension; DM: Diabetes mellitus; CVD: Cardiovascular disease; AVF: Arteriovenous fistula; CVC: Central venous catheter; Pearson correlation, independent-student T and Mann-whitney U tests were used in this table. Pearson correlation (r) tests were used for parametric data and spearman correlation (rho) tests were used for non-parametric data.

Statistical Analysis

Statistical analysis was performed using SPSS version 26.0 software (IBM Corp., Armonk, NY, USA). Descriptive data were expressed in mean±standard deviation, median (interquartile range [IQR]), number, and frequency, where applicable. The Kolmogorov-Smirnov test, coefficient of variation, and histogram distribution were used to understand that the data showed a normal distribution. The Student t-test was used to compare normally distributed variables between the groups, while the Mann–Whitney U test was used to compare non-normally distributed variables between the groups. The chi-square test was performed to analyze categorical variables. The Pearson correlation coefficient was used to identify a possible correlation between the DSI and other independent variables. A multivariate linear regression analysis was done to further analyze the correlation between the DSI and other independent variables. In addition, adjustments were made for confounding factors in the relevant analysis. Pearson correlation (r) tests were used for parametric data, and spearman correlation (rho) tests were used for non-parametric data. The Kruskal–Wallis H (H) test was used in the analysis of the data, which consisted of three nonparametric groups. The ANOVA test was used in the analysis of two independent and parametric groups, and then post-hock subgroup analysis was performed with the Bonferroni test. A $p<0.05$ was considered statistically significant.

RESULTS

A total of 92 patients undergoing HD for 4 h in each session, three times a week, were included in this study. Of the patients, 55 were males and 37 were females, with a mean age of 59.95±14.9 (range, 33–88) years. The mean age was similar between the two sexes (U=963.5, $p>0.05$). The patients were divided into three groups according to age: 18–49 years, 50–64 years, and ≥65 years (Table 1).

The median duration of HD was 60.0 (IQR: 20.8–103.5) months. The descriptive data of the patients is summarized in Table 2. The type of vascular access was arteriovenous fistula (AVF) in 59 (64.1%) patients and central venous catheter (CVC) in 33 (35.9%) patients (Table 1). The dose of HD was significantly higher in patients receiving HD via AVF ($p<0.001$); however, the mean DSI scores were significantly lower ($p<0.001$) (Table 2). The most common symptoms were fatigue (91.3%), decreased sexual satisfaction (89.1%), anxiety (87.0%), sadness (85.9%), and irritability (83.7%) (Table 3). In this study, the Cronbach alpha value for internal consistency was calculated 0.94.

TABLE 3. Frequency and severity of symptoms experienced by patients according to the DSI

		Yes		DSI Mean±SD
		n[a]	%	
1	Feeling tired or lack of in energy	84	91.3	2.83±1.3
2	Difficulty becoming sexually aroused	82	89.1	2.71±1.5
3	Feeling anxious	80	87.0	2.89±1.4
4	Feeling Sad	79	85.9	2.80±1.5
5	Feeling nervous	77	83.7	2.64±1.5
6	Decreased interest in sex	77	83.7	2.47±1.6
7	Worrying	76	82.6	2.54±1.5
8	Feeling irritable	75	81.5	2.54±1.5
9	Bone and Joint pain	73	79.3	2.51±1.6
10	Trouble staying asleep	70	76.1	2.55±1.7
11	Itching	67	72.8	2.13±1.6
12	Trouble falling asleep	66	71.7	2.36±1.7
13	Muscle soreness	66	71.7	2.34±1.7
14	Headache	63	68.5	1.79±1.5
15	Numbness or tingling in feet	62	67.4	1.76±1.5
16	Muscle cramps	61	66.3	1.47±1.2
17	Dry skin	60	65.2	2.00±1.7
18	Restless legs or difficulty in keeping legs still	59	64.1	1.84±1.6
19	Difficulty concentrating	58	63.0	1.89±1.7
20	Dry mouth	57	62.0	1.65±1.5
21	Lightheadedness or dizziness	52	56.5	1.47±1.5
22	Shortness of breath	48	52.2	1.25±1.4
23	Cough	42	45.7	0.96±1.2
24	Swelling in legs	40	43.5	0.96±1.2
25	Decreased appetite	38	41.3	0.95±1.3
26	Nausea	33	35.9	0.86±1.3
27	Chest pain	30	32.6	0.71±1.1
28	Constipation	27	29.3	0.68±1.2
29	Vomiting	20	21.7	0.50±1.0
30	Diarrhea	12	13.0	0.30±0.9
	Toatal DSIs			54.35±26.0

SD: Standard deviation; a: There were no questions left blank in the survey; DSIs: Dialysis Symptom Index score. Total Cronbach alpha: 0.940.

The mean total DSI score was 54.35±26.0. The mean total DSI score of female patients was significantly higher than that of male patients (67.46±21.7 vs. 45.53±25.0, respectively; U=502.0, $p<0.001$) (Table 1). There was a significant correlation between age and DSI ($p<0.001$). In particular, the mean DSI score was significantly higher in the ≥65 age group ($p<0.001$) (Table 1). The correlation analysis results are shown in Table 1.

A successful regression model was created in the analysis with independent variables such as gender, age, economic status, employment status, presence of a care assistant, and educational status, which have a significant correlation between DSIs ($F[6,85]=9.34$, $p<0.001$). It was concluded that 36% of the variance in the dependent variable, DSI, was explained by the independent variables (R^2 adjusted=0.36). The multivariate regression analysis revealed that DSI was significantly correlated

Table 4. Correlation analysis between the DSI and dialysis dose and biochemical parameters

	(n=92) %	Mean±SD	DSI score± SD	r	p
spKt/V					
Total	100	1.28±0.4	54.35±26.0	r=-0.763	<**0.001**
<1.2	40.2	0.92±0.1	78.27±12.5	t=12.01	<**0.001**
≥1.2	59.8	1.52±0.2	38.25±19.4		
Creatinine (mg/dL)	100	9.59±3.0	54.35±26.0	r=-0.367	<**0.001**
Albumin (g/dL)					
Total	100	3.43±0.4	54.35±26.0	r=-0.374	<**0.001**
<3.5	40.2	3.01±0.3	65.73±23.4	t=3.67	<**0.001**
≥3.5	59.8	3.72±0.2	46.69±25.0		
Phosphorus (mg/dL)					
Total	100	4.56±1.2	54.35±26.0	r=-0.249	**0.017**
<3.5	19.4	2.81±0.4	72.06±29.7	F=5.89	**0.004**
3.5–5.5	59.1	4.58±0.6	49.15±22.4		
>5.5	20.4	6.15±0.6	52.63±25.9		
Sodium (mEq/L)	100	135.78±2.9	54.35±26.0	r=-0.126	0.270
Potassium (mEq/L)					
Total	100	5.11±0.8	54.35±26.0	r=-0.055	0.605
<3	0.0		0.0	F=1.26	0.265
3–5	44.6	4.38±0.5	57.73±27.0		
>5	55.4	5.69±0.5	51.62±25.1		
PTH (pg/mL)					
Total	100	528.31±482.1	54.35±26.0	r=-0.012	0.909
<100	15.2	47.63±26.3	48.07±15.2	F=3.24	**0.044**
100–300	23.9	194.05±45.9	66.18±25.5		
>300	60.2	779.79±464.4	51.27±27.1		
Ferritin (ng/mL)					
Total	100	414.65±489.3	54.35±26.0	r=0.295	**0.004**
Glucose (mg/dL)					
Total	100	123.62±47.2	54.35±26.0	r=-0.014	0.898
CRP (mg/dL)					
Total	100	1.50±2.0	54.35±26.0	r=0.239	**0.022**
Calcium (mg/dL)					
Total	100	8.62±1.0	54.35±26.0	r=0.001	0.995
<8.4	39.1	7.68±0.6	54.94±27.2	F=0.184	0.832
8.4-9.5	42.4	8.92±0.3	55.31±25.1		
>9.5	18.5	9.91±0.3	50.88±26.6		
CaxP product					
Total	100	39.14±10.7	54.35±26.0	r=-0.227	**0.029**
<55	94.6	37.82±9.4	53.77±26.2	F=-0.87	0.377
≥55	5.4	62.07±6.5	64.40±20.9		
Hemoglobin (g/dL)					
Total	100	10.77±1.7	54.35±26.0	r=-0.392	<**0.001**
<11.5	70.7	9.92±1.1	58.26±27.3	F=2.78	0.068
11.5-13	18.5	12.17±0.3	42.76±23.5		
≥13	10.9	13.89±0.5	48.60±12.4		
Hematocrit (%)					
Total	100	32.84±5.5	54.35±26.0	r=-0.429	<**0.001**

SD: Standard deviation; PTH: Parathyroid hormone; CRP: C-reactive protein; F: ANOVA; r: Pearson correlation; t: independent-student T.

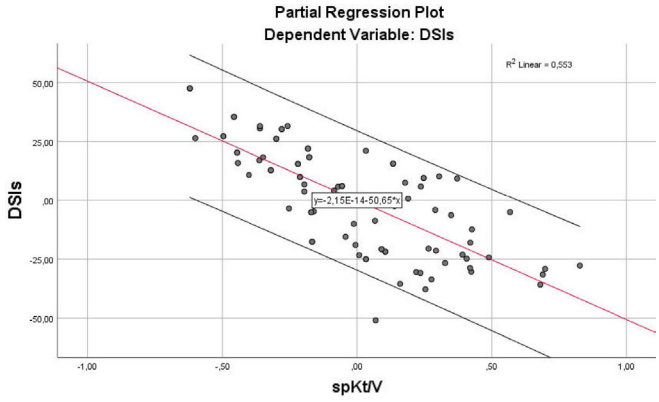

FIGURE 1. Linearity relationship between DSIs and spKt/V.

R^2: linear=0.553. It was obtained from multiple linear regression analysis.

with age, sex, and economic status ([β=−0.38, t(85)=-3.83, p<0.001, pr^2=0.15], [β=0.30, t(85)=2.43, p<0.05, pr^2=0.07], [β=−0.33, t(85)=-3.27, p<0.01, pr^2=0.11], respectively). However, no correlation was found between the DSI scores and employment status, the need for a caregiver, or education status (p>0.05).

The mean spKt/V ratio was 1.28±0.36, indicating a significant correlation with the DSI (r=-0.76, p<0.001). The mean DSI score was significantly higher in the patients with a spKt/V ratio of <1.2 (p<0.001) (Table 1). There was a significant correlation between the DSI scores and serum creatinine, albumin, phosphorus, ferritin, C-reactive protein (CRP), hemoglobin, hematocrit, spKt/V, and CaXP product (p<0.001). However, no significant correlation was found between the DSI scores and sodium, potassium, parathyroid hormone, glucose, or calcium levels (p>0.05). Correlation analysis results of biochemical parameters, spKt/V ratio, and DSI scores are presented in Table 4.

There was a linear correlation between the spKt/V ratio and DSI scores (Fig. 1). Multivariate linear regression analysis was performed to predict the relationship between DSI and independent variables such as creatinine, spKt/V, albumin, phosphorus, ferritin, CRP, CaxP product, Hb, and Hct (F[9,82]=19.09, p<0.001). It was concluded that 64% of the variance in DSI (R^2 adjusted=0.641) was explained by the independent variables. Multivariate regression analysis revealed that the spKt/V ratio was a significant and independent predictor of DSI scores (β=−0.70, t(82)= −10.1, p<0.001, pr^2=0.55). On the other hand, serum creatinine, albumin, phosphorus, ferritin, CRP, CaXP product, hemoglobin, and hematocrit were not independent predictors of DSI (p>0.05).

DISCUSSION

In the present study, we evaluated the relationship between DSI scores and HD adequacy in patients with CKD. Our study results showed that the frequency and severity of dialysis-related symptoms were lower in patients with a spKt/V ratio of ≥1.2. The multivariate regression analysis also revealed that there was a significant correlation between the spKt/V ratio and DSI scores, and the spKt/V ratio was an independent predictor of DSI.

In a study, You et al. [15] found a correlation between the low HD dose and symptom severity. In another study, however, there was no significant correlation between the DSI scores and dialysis adequacy [16]. The exact pathogenesis of symptoms is unclear in patients receiving HD, although such symptoms were thought to be related to uremic toxins [17]. The most common symptoms are fatigue or lethargy (71.3%), dry skin (61.5%), difficulty falling asleep (44.3%), muscle cramps (42.6%), and itching (42.6%). In our study, the most common symptoms were fatigue or lethargy (91.3%), decreased sexual satisfaction (89.1%), anxiety (87.0%), sadness (86.9%), and irritability (83.7%). Although previous studies reported a moderate severity of symptom burden in HD patients using DSI [18, 19], the mean DSI scores were higher in our study.

In a study investigating the association between biochemical parameters and symptom burden, lower dialysis adequacy calculated based on the spKt/V ratio and URR was associated with higher uremic symptom burden [15]. In the present study, a spKt/V ratio of <1.2 was found to be significantly correlated with a higher symptom burden. In their study, Canaud et al. [20] demonstrated that the loss of dialysis efficacy using CVC was 6%, although the spKt/V ratio values remained above the recommended values in all patients (spKt/V: ≥1.2). On the other hand, in our study, the spKt/V ratio of the HD patients with AVF access was significantly higher than that of those receiving HD with a CVC (1.37±0.4 vs. 1.12±0.3, respectively). In a study by Kim et al. [21], access with an AVF or arteriovenous graft was associated with improved health-related QoL and lower depression scores than those undergoing HD with a CVC. In another study, the lack of dialysis adequacy impaired the QoL of the patients, and an enhanced dialysis dose improved many components of the QoL [22]. Similarly, in our study, the mean DSI score was significantly lower in HD patients with an AVF than those with a CVC (47.25±24.9 vs. 67.03±23.2, respectively).

In the present study, we found a significant and independent correlation between the DSI scores and age, sex, and economic status. Female sex was significantly correlated with the symptom burden in our study, consistent with previous studies [23, 24]. We also found a significant correlation between dialysis adequacy and age, similar to the previous finding [25]. In the post-hoc analysis, there was no significant difference in the dialysis adequacy between the 18–49 and 50–64 age groups; however, the dialysis adequacy was significantly lower in the ≥65 age group. In a study, Hintistan and Deniz [24] found no significant correlation between the DSI scores and the age of the patient; however, we observed a significant correlation between these two variables in our study. There was no significant difference in the mean DSI scores between the 18–49 and 50–64 age groups; however, the mean DSI scores significantly increased in the ≥65 age group. Furthermore, we found a significant correlation between the DSI scores and education status, and a binary comparison revealed a significantly higher symptom burden in the illiterate patients. In a study, Somji et al. [26] reported that male sex and hemoglobin levels of <10 g/dL were associated with the lack of dialysis adequacy. In the aforementioned study, the delivered HD dose was significantly lower in the patients receiving ESA (spKt/V: 1.17±0.4) with a significantly higher DSI. This can be attributed to the inadequate dialysis and additional symptoms related to coexisting anemia in these patients.

Despite all this, our study has some limitations. The relatively small sample size, the inequal number of patients with and without dialysis adequacy, the evaluation of symptom burden using only a single index, and the estimation of DSI based on a limited timeframe can be regarded as limitations.

Conclusions

The DSI is a simple and feasible tool for HD patients. Our study results suggest that dialysis adequacy is an independent predictor of DSI. If an adequate dialysis dose is delivered, symptom burden may dramatically decrease. Based on these findings, the dialysis dose should be revised at a high level of symptom burden, and plans to improve the delivered dose should be developed. Further well-designed, large-scale prospective studies are warranted to draw more reliable conclusions on this subject.

Acknowledgements: We would like to thank Ozgul Akdeniz, a hemodialysis nurse, for helping us with data collection and data entry.

Ethics Committee Approval: The Malatya Training and Research Hospital Clinical Research Ethics Committee granted approval for this study (date: 31.10.2022, number: 2022/178).

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study has received no financial support.

Authorship Contributions: Concept – TK, IP; Design – TK, IP; Supervision – TK, IP; Fundings – TK, IP; Materials – TK, IP; Data collection and/or processing – TK; Analysis and/or interpretation – TK; Literature review – TK; Writing – TK; Critical review – TK, IP.

REFERENCES

1. Levin A, Stevens PE. Summary of KDIGO 2012 CKD Guideline: behind the scenes, need for guidance, and a framework for moving forward. Kidney Int 2014;85:49–61.
2. Hill NR, Fatoba ST, Oke JL, Hirst JA, O'Callaghan CA, Lasserson DS, et al. Global prevalence of chronic kidney disease - a systematic review and meta-analysis. PloS One 2016;11:e0158765.
3. Seyahi N, Ateş K, Süleymanlar G. Current Status of renal replacement therapy in Turkey: a summary of the Turkish Society of Nephrology registry report. Turk J Nephrol 2020;29:6–11.
4. Jones CB, Bargman JM. Should we look beyond Kt/V urea in assessing dialysis adequacy? Semin Dial 2018;31:420–9.
5. Barzegar H, Moosazadeh M, Jafari H, Esmaeili R. Evaluation of dialysis adequacy in hemodialysis patients: a systematic review. Urol J 2016;13:2744–9.
6. Daugirdas JT. Kt/V (and especially its modifications) remains a useful measure of hemodialysis dose. Kidney Int 2015;88:466–73.
7. Gotch FA, Levin NW, Port FK, Wolfe RA, Uehlinger DE. Clinical outcome relative to the dose of dialysis is not what you think: the fallacy of the mean. Am J Kidney Dis 1997;30:1–15.
8. National Kidney Foundation. KDOQI Clinical Practice Guideline for Hemodialysis Adequacy: 2015 update. Am J Kidney Dis 2015;66:884–930. Erratum in: Am J Kidney Dis 2016;67:534.
9. Vaidya SR, Aeddula NR. Chronic Renal Failure. In: StatPearls. Treasure Island, FL: StatPearls Publishing; 2023.
10. Murtagh FE, Addington-Hall J, Higginson IJ. The prevalence of symptoms in end-stage renal disease: a systematic review. Adv Chronic Kidney Dis 2007;14:82–99.
11. Yong DS, Kwok AO, Wong DM, Suen MH, Chen WT, Tse DM. Symptom burden and quality of life in end-stage renal disease: a study of 179 patients on dialysis and palliative care. Palliat Med 2009;23:111–9.
12. Weisbord SD, Fried LF, Arnold RM, Rotondi AJ, Fine MJ, Levenson DJ, et al. Development of a symptom assessment instrument for chronic hemodialysis patients: the dialysis symptom index. Pain Symptom Manage 2004;27:226–40.
13. Onsoz HB, Yeşilbalkan OU. Reliability and validity of the Turkish version of the Dialysis Symptom Index in chronic hemodialysis patients. Turk Neph Dial Transpl 2013;22:60–7.
14. Daugirdas JT. Second generation logarithmic estimates of single-pool variable volume Kt/V: an analysis of error. J Am Soc Nephrol 1993;4:1205–13.

15. You AS, Kalantar SS, Norris KC, Peralta RA, Narasaki Y, Fischman R, et al. Dialysis symptom index burden and symptom clusters in a prospective cohort of dialysis patients. J Nephrol 2022;35:1427–36.
16. Ozen N, Cepken T, Sousa CN. Does adequate hemodialysis prevent symptoms?: A national cross-sectional survey. Clin Nurs Res 2021;30:334–42.
17. Meyer TW, Hostetter TH. Uremia. N Engl J Med 2007;357:1316–25.
18. Akgöz N, Arslan S. Examination of symptoms in patients who are on hemodialysis treatment. [Article in Turkish]. J Nephrol Nurs 2017;1:20–8.
19. Demiroğlu S, Bülbül E. The relationship of patients receiving hemodialysis with depression, anxiety, stress conditions and dialysis symptoms. [Article in Turkish]. J Nephrol Nurs 2021;16:124–33.
20. Canaud B, Leray-Moragues H, Kerkeni N, Bosc JY, Martin K. Effective flow performances and dialysis doses delivered with permanent catheters: a 24-month comparative study of permanent catheters versus arterio-venous vascular accesses. Nephrol Dial Transplant 2002;17:1286–92.
21. Kim DH, Park JI, Lee JP, Kim YL, Kang SW, Yang CW, et al. The effects of vascular access types on the survival and quality of life and depression in the incident hemodialysis patients. Ren Fail 2020;42:30–9.
22. Hasan LM, Shaheen DAH, El Kannishy GAH, Sayed-Ahmed NAH, Abd El Wahab AM. Is health-related quality of life associated with adequacy of hemodialysis in chronic kidney disease patients? BMC Nephrol 2021;22:334.
23. Weisbord SD, Fried LF, Arnold RM, Fine MJ, Levenson DJ, Peterson RA, et al. Prevalence, severity, and importance of physical and emotional symptoms in chronic hemodialysis patients J Am Soc Nephrol 2005;16:2487–94.
24. Hintistan S, Deniz A. Evaluation of symptoms in patients undergoing hemodialysis. [Article in Turkish]. Bezmialem Sci 2018;6:112–8.
25. Stosovic MD, Petrovic MZ, Vujisic-Tesic BD, Stanojevic ML, Simic-Ogrizovic SP, Jovanovic DB, et al. Predictive value of echocardiography and its relation to Kt/V and anthropometric parameters in hemodialysis patients. Ren Fail 2015;37:589–96.
26. Somji SS, Ruggajo P, Moledina S. Adequacy of hemodialysis and its associated factors among patients undergoing chronic hemodialysis in Dar es Salaam, Tanzania. Int J Nephrol 2020;2020:9863065.