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Sleep Quality Among Iranian Hemodialysis Patients: A Multicenter Study

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Background: Sleep disorders are prevalent complication in patients with end-stage renal disease undergoing hemodialysis (HD). The factors affecting sleep quality (SQ) of patients on HD have not been completely recognized yet. In addition, some studies have shown that poor SQ increases the risk of mortality in patients on HD.

Objectives: This study aimed to identify the prevalence of poor SQ and its associated risk factors in Iranian patients on HD.

Patients and Methods: This cross-sectional and multicenter study was conducted on 6878 patients on HD from 132 dialysis centers in Iran. Sleep domain of disease specific core of KDCS-SF questionnaire and generic core of this questionnaire (SF-36) were used to assess patients' SQ and quality of life (QoL), respectively. A poor SQ was defined as a score of ≤ 61.2. Logistic and linear regression analyses were applied to assess predictors of SQ and their associations.

Results: The mean age of patients was 54.4 ± 17.1 years and 39.7% of patients were > 60 years old. The majority of our patients had poor SQ (60.6%). Patients with diabetes mellitus were significantly more likely to have poor quality of sleep (63.4%). In logistic regression analysis, there were significant correlation between good SQ and younger age, shorter dialysis vintage, less muscle cramp, high QoL, high cognitive function score, and high sexual function. In addition, linear regression showed a significant association among SQ, QoL, and hospital stay as an outcome.

Conclusions: With improving some factors and QoL of patients on HD, we can promote SQ in these patients that it might lead to reduction in length of hospital stay.

Keywords: Sleep; Quality of Life; Hospitalization; Questionnaire

1. Background

Chronic kidney disease (CKD) and end-stage renal disease (ESRD) have become worldwide public health problems. The prevalence of ESRD is steadily rising in Iran. Its prevalence was 700000 in 2004 and its incidence rate was 173 per 100000 people in Iran (1). Previous study has shown the prevalence and incidence of ESRD is increasing in Iran (2). These conditions rise patient morbidity and mortality risks and impose a huge cost to the countries health system (3). Hemodialysis (HD) is one of the lifesaving renal replacement therapies in patients with ESRD. There is a high prevalence of sleep disorders including sleep apnea syndrome, restless legs syndrome (RLS), sleep-disordered breathing, and excessive daytime sleepiness in patients on HD (4). Different studies evaluated the effects of various factors such as laboratory, sociodemographic (5), and health-related quality of life (HRQOL) (6) on sleep quality (SQ) of patients on HD; however, the factors affecting SQ of patients on HD have not been recognized completely yet. In addition, some studies have shown poor SQ increases the risk of mortality in patients on HD (6, 7); hence, finding the risk factors of SQ might decrease mortality and morbidity of these patients.

2. Objectives

This study aimed to determine the prevalence of poor SQ and to identify its risk factors in patients on HD.

3. Patients and Methods

3.1. Patients

This cross-sectional multicenter study was conducted on 6979 patients on HD in 132 dialysis centers in Iran from October 2010 to August 2011. The following inclusion criteria were applied: age > 13 years, individuals with stable clinical conditions, at least three-month history of HD, and receiving HD three times a week (each session lasting three to four hours). Patients with history of hospitalization for an acute illness, those with vascular access failure including those on dialysis via temporary central venous catheters, and those who refused to answer to the questionnaire were excluded from the study. The study protocol was approved by Ethics Committee of Baqiyatallah University of Medical Sciences, Tehran, Iran.

3.2. Instruments

KDCS-SF version 1.3 questionnaire (8) was used in this multicenter study. The KDCS-SF is a questionnaire to asses quality of life (QoL) and includes generic (SF-36) and disease-specific cores. The definition and exploration of the KDCS-SF and its components have been evaluated in previous study (9) and the comprehensive translation and validation of SF-36 health survey have been explained in another study (10). Sleep domain of disease-specific core of KDCS-SF questionnaire was used to assess patients' SQ. This domain contains four questions. In question No. 1 (Q_1), patients were asked "on a scale from zero to ten, how would you rate your sleep overall?" Scores zero and ten correspond to very bad and very good SQ, respectively. In three other questions (Q_2-Q_4), patients were asked about the preceding four weeks: "How often have you been awaken during the night and had trouble falling asleep again?", "have you got the amount of the sleep you need?", and "have trouble staying awake during the day?" In these questions, patients choose one answer between these following responses: "never", "a few times", "sometimes", "a good bit of the time"," most of the time" and "always". In Q_1, scores zero to ten converted to scores zero to 100 for analysis. Regarding Q_2 and Q_4, patients were scored zero when they chose "always" and 100 when chose "never" and 20, 40, 60, and 80 consecutively for choices between "always" and "never". In Q_3, patients were scored 0, 20, 40, 60, 80, and 100 consecutively for choices from "never" through "always". Finally, we specified a total score of sleep component as SQ in analysis. Higher SQ score meant better quality of sleep. We categorized patients as good sleepers (SQ $\leq$ 61.2) and poor sleepers (SQ > 61.2). To obtain this cutoff point, we statistically depicted receiver operating characteristic (ROC) curve using physical component summary (PCS; one of the two components of SF-36 questionnaire), because the association between PCS and SQ have been recognized previously (6). As we searched, we found a study (11) that had evaluated different cutoff points for PCS and finally, had chosen 60 as a cutoff score with 11.1 as likelihood ratio of positive test. Thus, using cutoff point of 60 for PCS, we drew ROC curve. After evaluating various cutoff points, we chose 61.2 as SQ cutoff point with 63.5% sensitivity and 67% specificity. Total SF-36 score was also considered as QoL. In addition, some of the symptoms from the symptoms/problems component of the questionnaire that were related to sleep were evaluated in this study as following: soreness in muscle, cramps, itchy skin, dry skin, and numbness in hands or feet. These symptoms were evaluated in the questionnaire by asking patients to answer one question concerning the extent of being bothered by mentioned symptoms during the preceding four weeks. Patients had to choose one of the following choices: "never", "somewhat bothered", "moderately bothered", "very much bothered" and "extremely bothered". These responses were scored consecutively as 100, 80, 60, 40, 20, and 0 for analysis. Two questions of questionnaire were used for hospital stay during the preceding six months: "Did you stay in any hospital overnight or longer?" and "Did you receive care at a hospital, but came home the same day?" Total days obtained from answers to these questions were considered as hospitalization days.

3.3. Data Collection

Sociodemographic and clinical data including age, sex, cause of dialysis such as diabetes mellitus (DM) or hypertension (HTN), work status (employed, unemployed, retired, housekeeper, or student), duration of dialysis, educational level, marital state, hemoglobin (Hb), ferritin, total iron binding capacity (TIBC), transferrin saturation (serum iron/TIBC, Fe/TIBC), calcium-phosphorus (Ca × P) product, parathyroid hormone (PTH) levels, serum uric acid, fasting blood sugar (FBS), serum albumin (Alb), triglyceride (TG), cholesterol (Chol), low-density lipoprotein (LDL), and high-density lipoprotein (HDL) were collected. Educational level was specified in four groups: uneducated, grade I (less than six years education), grade II (6 to 12 years education), and grade III (> 12 years education). In addition, the Kt/V was used to evaluate adequacy of dialysis using 1 and 1.2 as cutoff point. The number of consumed drugs was defined as the number of drugs that patient had consumed for longer than one week.

3.4. Statistical Analysis

Socio-economic and paraclinical variables and some of the components of the KDCS-SF questionnaire were evaluated and their associations with sleep component were analyzed. We used cutoff point of 10 and 11 g/dL (100 and 110 g/L) for Hb, 20% and 50% for Fe/TIBC, 100 ng/mL (224.20 pmol/L) for ferritin, 55 for Ca × P, 150 and 300 ng/L for PTH, 6 mg/dL (356.91 μmol/L) for uric acid, 126 mg/dL (6.99 mmol/L) for FBS, 40 g/L for albumin, 250 mg/dL (6.48 mmol/L) for Chol, 200 mg/dL (2.26 mmol/L) for TG, 70 mg/dL (1.81 mmol/L) for LDL, 40 mg/dL (1.04 mmol/L) for HDL, and 1 and 1.2 for Kt/V according to Handbook of Dialysis (12). SPSS 20 for windows (IBM Inc., Somers, NY, USA) was used for statistical analysis. After univariate analysis using Chi square and Mann Whitney U tests, variables with P value < 0.2 were entered to logistic regression model and Final model was obtained when all of P values were < 0.1. A P value < 0.05 was considered statistically significant. Moreover, Stata/SE version 11.2 (College Station, TX 77845, USA) was applied for linear regression analysis for hospital stay as an outcome.

4. Results

Among 6979 patients on HD, 6878 individuals (57% male and 43% female) completed the sleep component of questionnaire. Their ages ranged from 18 to 99 years, with a mean age of 54.4 ± 17.1 years. There was a higher proportion of older patients (> 60 years old) in this study (39.7%); however, 28.6% of patients were younger than 46 years. The patients' sociodemographic and laboratory characteristics are shown in Tables 1 and 2. HTN was the most common underlying disease (32%) among the patients on HD, followed by DM (25.4%).

4.1. The Correlation of Socio-Demographic Characteristics and Quality of Sleep

The mean SQ score was 55.9 ± 19.9. The majority of our patients had poor SQ (60.6%). Patients with DM were significantly more likely to have poor SQ (63.4%) in comparison to individuals with other underlying diseases. We found that female sex, DM, older age, widowhood, being housekeeper, being unemployed, longer duration of dialysis especially > 10 years, and lower educational level had a significant correlation with poor SQ (Table 1).

Table 1. The Correlation of Socio-Demographic Factors With Sleep Quality [a,b]

	Sleep Quality		P Value
	Poor	Good	
Cause of ESRD			0.004
Unknown	703 (58.7)	494 (41.3)	
DM	1066 (63.4)	616 (36.6)	
HTN	1288 (61.4)	811 (38.6)	
Other	927 (57.7)	680 (42.3)	
Total[c]	3984 (60.5)	2601 (39.5)	
Sex			0.001
Male	2281 (58.8)	1601 (41.2)	
Female	1853 (62.9)	1094 (37.1)	
Total[c]	4134 (60.5)	2695 (39.5)	
Age, y			0.000
≤ 45	941 (50.2)	935 (49.8)	
46-60	1272 (61.2)	807 (38.8)	
> 60	1735 (66.6)	871 (33.4)	
Total[c]	3948 (60.2)	2613 (39.8)	
Marital Status			0.000
Single	384 (49.3)	395 (50.7)	
Married	2976 (61.1)	1896 (38.9)	
Widow/Widower	697 (66.5)	351 (33.5)	
Total[c]	4057 (60.6)	2642 (39.4)	
Occupation Status			0.000
Employed	305 (45.3)	369 (54.7)	
Unemployed	1620 (62.0)	994 (38.0)	
Retired	779 (62.1)	475 (37.9)	
Housekeeper	1313 (62.8)	778 (37.2)	
Student	25 (35.7)	45 (64.3)	
Total[c]	4042 (60.3)	2661 (39.7)	
Duration of Dialysis, mo			0.000
≤ 12	1049 (55.6)	837 (44.4)	
12.1-60	1971 (59.9)	1321 (40.1)	
60.1-120	582 (68.0)	274 (32.0)	
> 120	170 (72.0)	66 (28.0)	
Total[c]	3772 (60.2)	2498 (39.8)	
Educational Level			0.000
Uneducated	1718 (66.4)	871 (33.6)	
Grade I	866 (59.0)	602 (41.0)	
Grade II	608 (51.1)	581 (48.9)	
Grade III	85 (42.3)	116 (57.7)	
Total[c]	3277 (60.2)	2170 (39.8)	

[a] Abbreviations: ESRD, end-stage renal disease; DM, diabetes mellitus; and HTN, hypertension.
[b] Data are presented as No. (%).
[c] Missing data is the reason of different total numbers.

Table 2. The Correlation Between Laboratory Data and Quality of Sleep [a,b]

	Sleep Quality		P Value
	Poor	Good	
Hb, g/dL			0.1
< 10	1630 (63.7)	930 (36.3)	
10-11	774 (58.5)	548 (41.5)	
> 11	1131 (61.8)	698 (38.2)	
Total[c]	3535 (61.9)	2176 (38.1)	
Fe/TIBC, %			0.5
≤ 20	212 (57.0)	160 (43.0)	
> 20, ≤ 50	298 (57.9)	217 (42.1)	
> 50	61 (61.6)	38 (38.4)	
Total[c]	571 (57.9)	415 (42.1)	
Ferritin, ng/mL			0.2
≤ 100	92 (56.1)	72 (43.9)	
> 100	968 (61.1)	617 (38.9)	
Total[c]	1060 (60.6)	689 (39.4)	
Ca×P			0.5
< 55	2301 (61.3)	1454 (38.7)	
≥ 55	1117 (62.3)	677 (37.7)	
Total[c]	3418 (61.6)	2131 (38.4)	
PTH, pg/mL			0.7
≤ 150	141 (65.0)	76 (35.0)	
150-300	92 (57.5)	68 (42.5)	
≥ 300	192 (62.7)	114 (37.3)	
Total[c]	425 (62.2)	258 (37.8)	
Uric acid, mg/dL			0.9
≤ 6	414 (57.1)	311 (42.9)	
> 6	927 (57.3)	692 (42.7)	
Total[c]	1341 (57.2)	1003 (42.8)	
FBS, mg/dL			0.002
≤ 126	1377 (56.7)	1053 (43.3)	
> 126	800 (62.0)	491 (38.0)	
Total[c]	2177 (58.5)	1544 (41.5)	
Alb, g/dL			0.05
≤ 4	840 (62.1)	512 (37.9)	
> 4	1291 (58.8)	905 (41.2)	
Total[c]	2131 (60.1)	1417 (39.9)	
Chol, mg/dL			0.9
≤ 250	2579 (60.1)	1710 (39.9)	
> 250	89 (59.7)	60 (40.3)	
Total[c]	2668 (60.1)	1770 (39.9)	
TG, mg/dL			0.4
≤ 200	1975 (59.8)	1328 (40.2)	
> 200	592 (61.3)	374 (38.7)	
Total[c]	2567 (60.1)	1702 (39.9)	
LDL, mg/dL			0.4
≤ 70	142 (62.8)	84 (37.2)	
> 70	273 (66.3)	139 (33.7)	
Total[c]	415 (65.0)	223 (35.0)	
HDL, mg/dL			0.5
≤ 40	251 (64.4)	139 (35.6)	
> 40	173 (67.1)	85 (32.9)	
Total[c]	424 (65.4)	224 (34.6)	
Kt/V			0.9
< 1	1079 (59.4)	739 (40.6)	
≥ 1, ≤ 1.2	434 (56.3)	337 (43.7)	
> 1.2	254 (61.1)	162 (38.9)	
Total[c]	1767 (58.8)	1238 (41.2)	

[a] Abbreviations: Hb, hemoglobin;Fe\TIBC, transferrin saturation; Ca × P, calcium-phosphorus product; PTH, parathyroid hormone; FBS, fasting blood sugar; Alb, albumin; Chol, cholesterol; TG, triglyceride; LDL, low-density lipoprotein; and HDL, high-density lipoprotein.
[b] Data are presented as No. (%).
[c] Missing data is the reason of different total numbers.

4.2. The Correlation of Laboratory Variables and Quality of Sleep

There was no significant difference between serum Hb, ferritin, PTH, Ca × P, uric acid, Alb, Kt/V, and lipid profile (Chol, TG, LDL, and HDL) between poor sleeper and good sleeper (Table 2). FBS > 126 mg/dL (6.99 mmol/L) was the only variable that increased the risk of poor sleep (P = 0.002) so that 62% of patients with DM were poor sleeper while only 56.7% of patients with FBS ≤ 126 mg/dL (≤ 6.99 mmol/L) had poor SQ. We also detected a U-shape correlation between Kt/V and SQ; patients with Kt/V between 1 and 1.2 were more likely to have good sleep; however, this correlation was not significant.

4.3. The Correlation of Clinical Symptoms and Quality of Sleep

A significant association was seen between muscle soreness, cramps, itchy skin, dry skin, and numbness in extremities with SQ (P ≤ 0.001). Table 3 shows the number and percentage of individual's response about the extent of being bordered by these symptoms that had led to poor SQ, from "not at all" to "extremely". Although each one of these symptoms were a risk factor of poor SQ, the percentage of poor SQ among individual's that were extremely bothered by muscle soreness was higher (81.4%) in comparison to other symptoms.

4.4. The Correlation Between Hospital Stay, Number of Patient's Drug Consumption, and Quality of Sleep

The mean of hospital stay was 6.3 ± 12.9 days (range, 0-105). The mean of hospital stay among patient with poor sleep was significantly higher (P ≤ 0.001) than among those with good sleep (6.8 vs. 5.4 days). Furthermore, patients with poor SQ were prescribed a greater number of medications when compared to individuals with good SQ (average number of drugs, 4.8 vs. 4.2; P ≤ 0.001).

4.5. The Correlation of Quality of Life Components and Quality of Sleep

The association between some components of KDCS-SF questionnaire including cognitive function, sexual function, social support, and patient satisfaction were analyzed with SQ. All of these components had a significant association with SQ (P ≤ 0.001). This means lower score of each component, which shows worse situation in the component, would increase the chance of poor SQ. In addition, total SF-36 score was also associated with SQ; in other words, the lower the score of QoL was, the worse the SQ would be (P ≤ 0.001).

4.6. Multivariate Logistic Regression; Effect of Factors on Quality of Sleep

After adjustment for covariates including causes of ESRD, sex, age, marital status, job status, dialysis duration, FBS, Alb, muscle soreness, cramps, itchy skin, dry skin, numbness in extremities, total SF-36 score, hospital stay, social support, cognitive function, patient satisfaction, and educational level, only younger age (< 45 years old; OR = 1.54), shorter dialysis vintage (≤ 60 months),

Table 3. Univariate Association Between Clinical Symptoms and Quality of Sleep [a]

	Sleep Quality		P Value
	Poor	Good	
Muscle soreness			≤ 0.001
Extremely	665 (81.4)	152 (18.6)	
Very Much	1085 (70.2)	461 (29.8)	
Moderately	869 (64.0)	488 (36.0)	
Somewhat	930 (56.7)	711 (43.3)	
Not at All	553 (39.2)	858 (60.8)	
Total[b]	4102 (60.6)	2670 (39.4)	
Cramps			≤ 0.001
Extremely	553 (78.1)	155 (21.9)	
Very Much	870 (73.9)	308 (26.1)	
Moderately	985 (64.3)	547 (35.7)	
Somewhat	939 (55.3)	759 (44.7)	
Not at All	721 (45.0)	880 (55.0)	
Total[b]	4068 (60.6)	2649 (39.4)	
Itchy Skin			≤ 0.001
Extremely	442 (69.7)	192 (30.3)	
Very Much	713 (72.9)	265 (27.1)	
Moderately	812 (65.5)	428 (34.5)	
Somewhat	896 (59.7)	605 (40.3)	
Not at All	1223 (51.2)	1165 (48.8)	
Total[b]	4086 (60.6)	2655 (39.4)	
Dry Skin			≤ 0.001
Extremely	292 (74.3)	101 (25.7)	
Very Much	726 (75.1)	241 (24.9)	
Moderately	800 (69.5)	351 (30.5)	
Somewhat	951 (62.4)	573 (37.6)	
Not at All	1271 (48.6)	1345 (51.4)	
Total[b]	4040 (60.7)	2611 (39.3)	
Numbness in Extremities			≤ 0.001
Extremely	317 (79.1)	84 (20.9)	
Very Much	653 (75.1)	216 (24.9)	
Moderately	932 (69.9)	401 (30.1)	
Somewhat	1046 (61.1)	665 (38.9)	
Not at All	932 (44.2)	1176 (55.8)	
Total[b]	3880 (60.4)	2542 (39.6)	

[a] Data are presented as No. (%).
[b] Missing data is the reason of different total numbers.

less muscle cramp, high QoL, high cognitive function score, and high sexual function had significant correlation with good SQ (Table 4).

Table 4. Logistic Regression Analysis Based on Factors Contributing to Sleep Quality in the Patients on Hemodialysis [a]

	P value	OR	SE (OR)	95% CI
Age, y				
≤ 45	0.005	1.540	0.237	(1.140-2.081)
46-60	0.248	1.191	0.179	(0.886-1.601)
> 60	baseline			
Duration of Dialysis, mo				
≤ 12	0.027	2.168	0.760	(1.090-4.311)
12.1-60	0.029	2.116	0. 727	(1.078-4.154)
60.1-120	0.646	1.187	0.442	(0.571-2.468)
> 120	Baseline			
Less Muscle Cramps	0.001	1.006	0.002	(1.002-1.010)
SF-36 Score	≤ 0.001	1.031	0.004	(1.023-1.039)
Cognitive Function	0.001	1.011	0.003	(1.004-1.017)
Sexual Function	0.017	1.005	0.002	(1.001-1.009)

[a] Abbreviations: OR, odds ratio; SE, standard error; and CI, confidence interval.

4.7. Hospital Stay as an Outcome

We evaluated the association between SQ, QoL, and hospital stay. After adjusting for sociodemographic and basic characteristics including age, sex, occupational status, marital state, educational level, duration of dialysis, and cause of ESRD in multivariate linear regression, we found a significant association among SQ (B = -1.307, P = 0.001), QoL (B = -0.043, P ≤ 0.001), and hospital stay.

5. Discussion

In the current study with a large number of patients, we found a new cutoff point for classification of SQ subscale of KDCS-SF questionnaire, which was used to assess the SQ by several studies (6, 7, 13-15). For example, Elder et al. (6) and Brekke et al. (7) applied Q_1 in sleep component of KDCS-SF questionnaire to assess self-reported SQ in patients on dialysis using 60 and 50 as cutoff points. Although some studies (13, 14) used the same instrument of the present study, they did not specify any cutoff points. To our knowledge, only one study (15), applied sleep subscale of KDCS-SF questionnaire and classified SQ in cutoff point of 60 using self-reported SQ in CKD. In the present study, we found 61.2 as a cutoff point with good values for sensitivity and specificity. Applying this cutoff point, 60.6% of our patients had poor SQ, which was consistent with findings in other studies (4, 16, 17). The prevalence of poor SQ among patients on HD ranges from 41% to 86% (4, 16, 17), while its prevalence in general population is less than 40% (range, 7%-40%) (18-20). In a study, insomnia symptoms occurred in 36.2% of general population (20); in addition, another investigation reported that 20.1% of general population had sleep difficulty (19). Thus, patients on HD have a high prevalence of sleep disorders and such studies that aim to find factors affecting SQ are important. Some studies showed QoL as a predictor for the length of hospital stay in patients on HD (9, 21). For example, Rostami et al. (9) reported an inverse association between HRQOL and hospital stay. Our study also demonstrated a negative correlation among SQ, QoL, and hospitalization even after adjusting for sociodemographic factors. The higher the SQ score was, the fewer the hospitalization days would be; ie, one point increase in SQ score would lead to 1.3 days decrease in hospital stay. It is obvious that improving of SQ and QoL in patients on HD would result in declining of costs too. In the present study, HTN and DM were most prevalent causes of ESRD. However, most studies reported DM as the most common cause of ESRD, followed by HTN (22, 23). Nevertheless, in some races and regions, HTN has been reported as the most common cause of ESRD (24, 25). The third common cause of ESRD was "unknown", which was similar to the reports by other studies (22, 23). Many patients were referred with advanced renal failure and their kidneys were shrunk in ultrasonography. Therefore, they did not need renal biopsy to confirm the diagnosis. In addition, patients with advanced age had higher chances of experiencing poor SQ. We found that a good SQ was significantly prevalent in patients younger than 45 years of age in comparison to older patients. Moreover, most investigators have revealed the association between age and SQ (5, 26). For example, in a study on 61 Patients on HD, Sabet et al. showed that younger patients had better SQ than older individuals did (5). Yoshioka et al. also found that SQ was reduced by aging (26). This finding might be partly due to bad nutritional status and less physical activity in elderly patients. The sex of the patients had no affect SQ in our study, which was consistent with other studies (27, 28). Nevertheless, few studies reported that poor SQ was significantly different between sexes (5, 29). In a series of 61 patients on HD, women had lower SQ in comparison to men (5). It was also demonstrated that in patients on HD, sleep apnea syndrome was frequently occurred in males (30) while RLS was more common in females (31) However, there were no differences in SQ between males and females in the present study. In several studies, the association between components of SF-36 questionnaire (PCS and MCS [Mental Component Summary]) with SQ has been evaluated (6, 32). In this study, we used total SF-36 score as QoL score and found a significant positive correlation between QoL and SQ. It means that patients with lower QoL score were more likely to have poor SQ. In addition, we found a significant association between SQ and all domains of SF-36 questionnaire including role-physical, bodily pain, general health, vitality (energy/fatigue), social functioning, mental health (emotional

well-being), and role-emotion, which was consistent with findings of other studies (6, 16). Iliescu et al. found that both PCS and MCS score had correlation with good SQ, even after controlling different confounders (16). However, Edalat-Nejad et al. (33) did not found any correlation between PCS and SQ, and conversely, Sathvik et al. (34) reported no association between MCS and SQ. There is a controversy over the role of Kt/V as dialysis adequacy. For example, iliescu et al. mentioned no association between Kt/V and SQ (16). Bastos et al. conducted a study on 100 patients on HD and revealed that individuals with excessive daytime sleepiness had lower score of the Kt/V index (27). Moreover, Mucsi et al. evaluated the association of RLS with age, sex, presence of DM, Kt/V, number of comorbid condition, and PTH levels in logistic regression analysis and found only Kt/V < 1.2 had significant association with RLS (35). Although we detected a U-shape correlation between Kt/V and SQ, this correlation was not significant in both univariate and multivariate analyses, which was consistent with findings of other studies (16, 32). Kt/V might not be a perfect index to assess dialysis adequacy or dialysis frequency would more significantly affect the SQ than dialysis quality would; therefore, we suggest a study to evaluate the role of dialysis frequency in SQ of patients on HD. There were significant differences between patients with duration of dialysis < 60 months and > 10 years in the present study. Patients with duration of dialysis shorter than 60 months had significantly better SQ in comparison to other individuals. Sabet et al. (5) showed that as duration of HD increased, the SQ would decrease. Sabbatini et al. (36) also conducted a study on 311 patients on HD and showed a significant association between insomnia and duration of dialysis > 12 months. It would be due to the overlap of diseases and symptoms-such as neurologic and cardiovascular disease that usually develop in patients who were on HD for a long time or renal osteodystrophy, which leads to bone pain and/or pruritus, which progress with time and can affect patients SQ. Several sleep-related sexual disorders such as sleep exacerbation of persistent sexual arousal syndrome and sleep-related painful erections have been expressed in general population (37). Nevertheless, to our knowledge, evaluating the influence of sexual dysfunction on SQ in patients on HD had not been done before. However, Robinson et al. (38) showed a strong association between sexual activity and QoL in older adults. Our study showed a positive correlation between sexual function and SQ in patients on HD. In other words, as score of sexual function component of KDQL questionnaire increased, SQ would increase.

Our study had some limitations due to its cross-sectional nature. First, we could not suggest a cause-and-effect relationship while we could show associations between study variables. Second, since we did not follow our patients, their mortality rate remained unrevealed. Thus, we could not evaluate association among SQ, QoL, and mortality. Third, we assessed quality of sleep overly by means of a component of KDQL questionnaire; therefore, we did not have any data about type of individuals' sleep disorders. With improving some amendable factors and QoL of patients on HD, we can promote their SQ that might lead to reduction in length of hospital stay. In addition, we found that age and dialysis duration had negative association with SQ. Since these are non-modifiable factors, earlier renal transplantation for patients on HD would help them. However, other studies need to evaluate and compare SQ between patients on HD and transplant patients.

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Authors' Contributions

Study concept and design and study supervision: Behzad Einollahi and Zohreh Rostami; acquisition of data: Behzad Einollahi and Mahmood Salesi; statistical analysis and interpretation of data: Mahmood Salesi and Mohsen Motalebi; drafting the manuscript: Eghlim Nemati; Critical revision of the manuscript for important intellectual content: Behzad Einollahi, Zohreh Rostami, and Mohsen Motalebi; and administrative, technical, and material support: Eghlim Nemati and Behzad Einollahi.

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