Sleep Quality in Patients Undergoing Long-term Hemodialysis Using the Pittsburgh Sleep Quality Index

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Abstract

Background: Sleep disturbances are common among uremic patients. However, limited data are available on predictors of the quality of sleep in this population.
Objectives: This study aimed to assess the quality of sleep in patients undergoing hemodialysis and investigate its predictors.
Methods: In this cross-sectional study, 197 patients on maintenance hemodialysis were consecutively included from three medical centers in Shiraz, southern Iran. They completed the Pittsburgh sleep quality index. Serum calcium, phosphorus, and hemoglobin levels were checked. We also assessed the neck circumference, dialysis shift, dialysis plan, diabetes history, body mass index (BMI), age, and sex.
Results: From a total of 197 patients, 124 cases were men. The mean age of the patients was 54.46 ± 14.84 years. Poor quality of sleep was frequent in 90.86% of the cases. Age, BMI, a history of diabetes mellitus and the product of calcium and phosphorus were independent factors affecting the quality of sleep. Serum calcium and phosphorus levels, hemoglobin, sex, dialysis shift, dialysis plan, neck circumference and dialysis quality showed to have no significant effect on the quality of sleep.
Conclusions: Poor quality of sleep is very frequent in patients on maintenance hemodialysis. Further studies are required for better understanding of risk factors associated with the poor quality of sleep to find possible treatments for these patients.

Keywords: Hemodialysis, Sleep, Questionnaire, Pittsburgh Sleep Quality Index, Chronic Kidney Disease

1. Background

For human beings, sleep is a natural physical need for maintaining physical-mental health. A poor quality of sleep can negatively affect personal emotions, cognitive processes, motivations, and the ability to focus, leading to loss of appetite, anxiety, nervousness, and depression (1-3). Sleep disorders disrupt normal sleep cycle and create dissipated sleep patterns, leading to an inadequate sleep quantity and quality, daytime malfunctioning, fatigue, and insomnia (3).

Restless leg syndrome is one of the subjective complaints in patients under hemodialysis. Patients often describe an irritating sensation in the muscle of the lower legs, which relieves by moving their legs and feet. The restless leg syndrome also contributes to psychiatric symptoms, confusion, anemia, and iron, calcium and phosphorus deficiencies, which is associated with increased mortality in patients undergoing hemodialysis. Apnea is defined as the cessation of respiration for at least 10 seconds, which is observed in 30% - 60% of patients undergoing dialysis, and in 2% - 4% of the general population (4). As the size of the neck base increases in patients with chronic kidney complications, there will be an increase in the sleep apnea syndrome (5).

The Pittsburgh sleep quality index (PSQI), a standardized questionnaire, was introduced in 1989 as a useful tool to assess sleep problems. It may be associated with anxiety, stress, depression, and schizophrenia in individuals taking it (6).

2. Objectives

This study was designed to evaluate sleep disorders in hemodialysis patients and its association with height, weight, age, sex, dialysis quality, neck circumference, body mass index (BMI), calcium, phosphorus, and hemoglobin, hopefully to be a basis for further studies and improvement of care in such patients.

3. Methods

This cross-sectional study was conducted on patients undergoing chronic hemodialysis referred to three dialysis centers (Sadra clinic, Namazi and Shahid Faghihi hospitals) affiliated to the Shiraz University of Medical Sciences, Shiraz, Iran. This study was approved by the medical school ethics board (No 5690) and verbal informed consent was obtained from the participants.

Distribution of patients to these three centers was not performed according to the severity of disease or concomitant problems. To provide the study population, half of the patients of each center were randomly included in the study, after meeting the following inclusion criteria: minimum age of 18, at least 3 months of hemodialysis, and 2 or 3

sessions of dialysis weekly. During June to August 2013, 197 patients were totally included in this study.

To perform this study, we planned to gather information from a Persian version of the PSQI, which was used and acknowledged, regarding its sensitivity and specificity, in previous studies. Farrahi et al. reported a Cronbach's alpha coefficient of 0.77 for the Persian version of this index which, compared to 0.83 for the English version, was reliable and applicable, which was used in this study with permission of the author (7).

According to the random table of numbers, we filled in the questionnaires at the patients' bedside after obtaining their permission. The interview conducted by one of the investigators. Also, some data were extracted from patients' charts.

In some studies the neck base circumference of 17 inches in men, and 16 inches in women were reported to have a direct relation with the sleep apnea syndrome (8). We also measured the patients' neck base circumference in a supine position using a flexible cloth ruler from the inferior part of the cricoid cartilage.

Quality of dialysis was measured by Kt/V. In this formula, K is indicative of dialyzer clearance (a measure of the amount of blood passing through the dialyzer), which is defined as mL/m, t represents time, and V is the volume of total body water. The last estimation of Kt/V from each patient was extracted from their charts. The BMI was calculated as the weight (kg) divided by the height squared (m^2). Patients' height and dry body weight were extracted from their charts.

The PSQI evaluates the attitude of patients about their quality of sleep in the past 4 weeks. This index has scores for the following 7 items: quality of sleep, delay in falling asleep, effective duration of sleep, sleep efficacy, sleep disorders, needed amount of sleep-inducing pills, and daytime performance. Each item has a score of 0 to 3 and these items collectively form an overall score of 0 to 21 (6). The total score of the PSQI questionnaire is calculated as the total sum of the scores of all seven groups of questions. It is necessary to mention that the questions are related to usual habits of sleeping, only in the last month.

Data were described using mean (± SD) and frequency (%). The odds ratio (OR) index and corresponding 95% confidence interval (CI) were used to assess the relationship between variables and sleep disturbance. Data were analyzed using the SPSS software version 18.0 (SPSS, Chicago, Illinois, USA). The significance level was considered to be P < 0.05 throughout the study.

4. Results

In this study which was performed on 197 patients undergoing chronic hemodialysis, total scores of PSQI were variable in a range of 0 to 20. The mean score was 9.51 ± 3.51. From a total of 197 patients, 179 (90.87%) had a poor quality of sleep (scores greater than 5) and 18 patients (9.13%) had acceptable quality of sleep (scores less than 5).

Patients with normal BMI (18.5 - 24.9) were 3.16 times more likely to have sleep disturbance when compared with those who have BMI < 18.5 (OR = 3.16, P = 0.027). However, patients with BMI > 25 were not significantly different (OR = 1.75, P = 0.317) (Table 1).

Sixty-eight patients were diabetic and 129 nondiabetic. The mean sleep quality score in diabetic and nondiabetic groups were 10.32 ± 3.95 and 9.085 ± 3.83.86, respectively (P = 0.034). Therefore, patients with diabetes have a significantly lower quality of sleep.

There was no statistical relationship between sleep disturbance and hypocalcemia (OR = 0.63, P = 0.232), hyperphosphatemia (OR = 1.60, P = 0.304), high product of calcium and phosphorus (OR = 1.50, P = 0.437).

Sixty-six patients had hemoglobin less than 11 mg/dL, 44 had hemoglobin 11 - 12 mg/dL, and 85 patients had hemoglobin of more than 12 mg/dL. No statistically significant difference was found in the quality of sleep among these three groups.

In the case of dialysis, no significant relationship was found between sleep disturbance and dialysis shift in afternoon (OR = 1.53, P = 0.309) or evening (OR = 0.93, P = 0.901).

Five patients had Kt/V < 1, 13 patients had Kt/V of 1 to 1.2, and 126 patients had Kt/V > 1.2. The mean sleep quality score of these 144 patients was 1.45 ± 0.31 (range = 0.42 - 2.81). No statistically significant difference was found between the quality of dialysis and quality of sleep.

Patients were divided into two groups, regarding their neck base circumference. Those 183 patients with normal neck base circumference had a mean sleep quality score of 9.37 ± 3.81. The other 14 patients with increased neck base circumference (more than 16 inches in women and 17 inches in men) had a mean score of 11.28 ± 4.87 (P = 0.207).

Relation between the use of sleep medication in the last month, experiences of sleep apnea, restless leg syndrome, pain, nightmares, confusion and delirium with quality of sleep were shown in Table 2. The mean sleep quality scores were 10.096 ± 4.052 and 9.169 ± 3.804 in 37 women and 124 men, respectively (P = 0.281).

5. Discussion

We found that 90.87% of the studied patients had a poor quality of sleep. There was a significant relation be-

Table 1. Correlation Between Different Variables and the Pittsburgh Sleep Quality Index > 5 in Patients Undergoing Long-term Hemodialysis

	Variable	Number (%)	PSQI > 5	Odds Ratio	95% CI	P Value
Age, year	< 30	14 (7.1)	10 (71.4)	1	-	-
	30 - 45	33 (16.8)	22 (66.7)	0.80	2.00 - 3.14	0.749
	45 - 65	94 (47.7)	79 (84.0)	2.11	0.58 - 7.61	0.255
	> 65	56 (28.4)	51 (91.0)	4.08	0.93 - 17.91	0.062
Sex	Female	73 (37.1)	61 (83.6)	1	-	-
	Male	124 (62.9)	101 (81.5)	0.86	0.40 - 1.86	0.708
Body mass index	< 18.5	23 (12.0)	15 (65.2)	1	-	-
	18.5 - 24.9	104 (54.2)	89 (85.6)	3.16	1.14 - 8.76	0.027
	25 - 25.9	47 (24.5)	36 (76.6)	1.75	0.59 - 5.20	0.317
	$\geq$ 30	18 (9.4)	17 (94.4)	9.07	1.01 - 81.15	0.49
Ca (mg/dL)	< 8.7	95 (48.7)	75 (78.9)	1	-	-
	8.7 - 10.20	97 (49.7)	83 (85.6)	0.63	0.30 - 1.34	0.232
P (mg/dL)	2.5 - 4.3	33 (16.9)	25 (75.8)	1	-	-
	> 4.3	162 (83.1)	135 (83.3)	1.60	0.65 - 3.92	0.304
Ca P Product	< 55	158 (81.0)	128 (81.0)	1	-	-
	$\geq$ 55	37 (19.0)	32 (86.5)	1.50	0.54 - 4.17	0.437
Hb (mg/dL)	< 11	66 (33.8)	51 (77.3)	0.61	0.27 - 1.40	0.246
	11 - 12	44 (22.6)	37 (84.1)	0.95	0.35 - 2.60	0.954
	> 12	85 (43.6)	72 (84.7)	1	-	-
Dialysis shift	Morning	106 (53.8)	85 (80.2)	1	-	-
	Noon	72 (36.5)	62 (86.1)	1.53	0.67 - 3.48	0.309
	Afternoon	19 (9.6)	15 (78.9)	0.93	0.28 - 3.08	0.901
Dialysis plan	Twice a week	45 (22.8)	32 (71.1)	1	-	-
	Three times a week	152 (77.2)	130 (85.5)	2.40	1.09 - 5.28	0.29
Restless leg syndrome	Less than once a week or nothing	129 (66.5)	101 (78.3)	1	-	-
	Once a week or more	32 (33.5)	29 (90.6)	2.68	0.76 - 9.45	0.125
Witnessed apnea	Less than once a week or nothing	174 (89.7)	142 (81.6)	1	-	-
	Once a week or more	14 (10.3)	13 (92.9)	2.93	0.37 - 23.21	0.309

Abbreviations: Ca, calcium; CI, confidence interval; Hb, hemoglobin; P, phosphorus; PSQI, the Pittsburgh sleep quality index.

tween the quality of sleep and BMI, age, diabetes mellitus, the product of calcium and phosphorus, use of sleep medication, sleep apnea, restless leg syndrome, pain during sleep, nightmares, and confusion and/or delirium. On the other hand, there was no significant relation between the quality of sleep and serum hemoglobin level, dialysis daily shift, having home mates, loud snoring, neck base circumference, sex, number of dialysis sessions, serum calcium level, serum phosphorus level, and quality of dialysis.

Most recent studies designed to evaluate the quality of sleep in patients undergoing chronic hemodialysis using the PSQI have reported a low quality of sleep in 64%-87% of the patients (1, 3, 4, 9-15). In our study, a low quality of sleep was found in 90.87% of the patients. In a study performed by Bastos et al., a low quality of sleep was reported in 75% of patients (16). Another study showed low quality of sleep in 53% of their study population (17).

Cengic et al. reported the mean sleeping hours of chronic dialysis patients to be around 4.9 hours, and the mean delay time in falling asleep as 48.2 minutes (4). Holly et al. reported the average of sleeping hours as 5.3 hours (18). In our study, the mean sleeping hours in the patients

Table 2. Evaluation and Analysis of Relation Between Different Variables and Quality of Sleep in Patients With Chronic Hemodialysis[a]

Recurrence		Variable						
		Using Sleep Medication	**Sleep Apnea Syndrome**	**Restless Leg Syndrome**	**Pain During Sleep**	**Nightmares**	**Confusion and/or Delirium**	**Sleep Apnea Syndrome in Relation with the Neck Base Circumference**
None in last month	Less than once a week	0.001	0.030	0.474	0.366	0.114	0.139	0.324
	Once or twice in last month	0.006	0.044	0.507	0.021	0.124	0.001	0.142
	3 times a week or more	0.000	0.001	0.001	0.000	0.000	0.000	0.146
Less than once a week	None in last month	0.001	0.030	0.474	0.366	0.114	0.139	0.324
	Once or twice in last month	0.662	0.778	0.275	0.545	0.571	0.097	0.062
	3 times a week or more	0.460	0.034	0.002	0.028	0.002	0.003	0.388
Once or twice in last month	None in last month	0.006	0.044	0.507	0.021	0.124	0.001	0.142
	Less than once weekly	0.662	0.778	0.275	0.545	0.571	0.097	0.062
	3 times a week or more	0.197	0.075	0.028	0.030	0.096	0.143	0.038
3 times a week or more	None in last month	0.000	0.001	0.001	0.000	0.000	0.000	0.146
	Less than once weekly	0.460	0.034	0.002	0.028	0.002	0.003	0.388
	Once or twice in last month	0.197	0.075	0.028	0.030	0.096	0.143	0.038

[a] P value < 0.05 is considered statistically significant.

was 5.34 hours, and the mean delay time in falling asleep was 39 minutes.

Different studies in this field have found restless leg syndrome in 18.4% to 84% of the patients undergoing chronic hemodialysis (2, 4, 10, 16, 18-23). In our study the prevalence of this syndrome among chronic hemodialysis patients was 45%. This difference in estimation of the prevalence of the restless leg syndrome in different studies could be attributed to the different criteria for defining this syndrome, the method by which the researcher has asked the patients about this syndrome, and different concepts of patients.

About relation between dialysis shift and the quality of sleep in chronic hemodialysis patients, the results vary across studies. Wang et al. found that patients who underwent hemodialysis in the morning shift had a better quality of sleep compared with other patients (24). Cengic et al. (4) and Masoumi et al. (14), however, believe that patients dialyzed in the third shift (evening shift) have a higher quality of sleep than others. Merlino et al. stated that those who were dialyzed in the morning shift had a lower quality of sleep (2). Bastos et al. mentioned no relationship between dialysis shift and the quality of sleep. Their study is so reliable in this matter, since there was no

significant difference between age, sex, BMI and the quality of dialysis of the patients of three shifts (16). Likewise, Trbojevic-Stankovic et al. reported no significant relationship between the dialysis shift and quality of sleep (15). In our study, there was no meaningful relationship between the dialysis shift and the quality of sleep either. This difference could be possibly due to the difference between dialysis timetables in dialysis centers. Also, patients who filled in the questionnaire about the nighttime sleep may have been dialyzed in different shifts of the day.

To clarify the relation between the serum hemoglobin level and the quality of sleep in hemodialysis patients, authors and researchers have different opinions. Baraz et al. (11), and Cengic et al. (4) believe that there is a relationship between a low quality of sleep and low serum hemoglobin, while other studies found no such relationship, similar to our results (10, 17, 23). This difference could possibly be attributed to the difference in BMIs of the patients, or difference in the laboratory differential references.

Many studies relate increase in age to a low quality of sleep in patients under chronic hemodialysis, (1, 2, 4, 9, 10, 15, 22, 23) while other studies do not show such relationship (14, 16, 17, 24). In our study, patients had a lower quality of sleep with increasing age, but only up to the age thresh-

old of 70. After 70 years of age, an increase in age was related to a better quality of sleep. Sabet et al. also observed the same result up to the threshold of 61 years old (10).

Most of the studies performed in this field have shown no relation between sex and the quality of sleep in patients under chronic hemodialysis, which is similar to the results of our study (2, 11, 13, 14, 16, 17, 24). Tel et al., Sabet et al., Trbojevic-Stankovic et al. and Einollahi et al. observed a lower quality of sleep in female patients (1, 10, 15, 23).

Most of the studies found no correlation between having diabetes mellitus and quality of sleep in patients under chronic hemodialysis (2, 10, 11, 13, 24). On the other hand, we and Einollahi et al. (23) observed a lower quality of sleep in patients with diabetes mellitus. Celik et al. believe that the quality of sleep was better in patients under hemodialysis with diabetes (9).

We found that overweight and obese patients had a lower quality of sleep than those with a normal BMI or underweight patients. Most previous studies did not find any relation between these two (2, 4, 14, 16). It is possible that coexisting factors such as depression and anxiety, which were related to the quality of sleep in our study, were also responsible for the difference in the quality of sleep between these two groups.

With respect to the serum phosphorus level and quality of sleep, some researchers found that patients with a higher serum phosphorus level had significantly lower sleep quality (4, 9), while others found no such relation (10, 15, 17), which is in accordance with the results of the present study. Cengic et al. (4) and Celik et al. (9) stated that the serum calcium level had no effect on the quality of sleep in their study population. Therefore, it seems possible that it had been the calcium level which had affected the quality of sleep in their studies, rather than the phosphorus level.

Three other studies, besides ours, have assessed the relationship between the serum calcium level and the quality of sleep in chronic hemodialysis patients, which showed that the serum calcium level had no effect on the quality of sleep of these patients, which is in consistent with our results (10, 15, 17).

Previous studies in this field have not paid much attention to the effect of the product of calcium and phosphorus on the quality of sleep. Bastos et al. mentioned only a mean of 47.84 for this product among their patients (16). Einollahi et al. found no relation between the product of calcium and phosphorus and quality of sleep (23). We, however, found a relation between a higher product of serum calcium and phosphorus levels and the quality of sleep, and suggest further studies to focus more on this relation.

Elias et al. found a direct relation between increase in the neck base circumference and the incidence of the sleep apnea syndrome in patients under chronic hemodialysis (mean =39.7 ± 6.3 centimeters) (5). Nicholl et al. also found similar results (mean = 40.70 ± 4.8 centimeters) (25). In our population, the mean neck base circumference was 37.5 ± 4.2 centimeters and we found no significant relation between the neck base circumference and the quality of sleep. The difference between our results and the two aforementioned studies could be due to the fact that they assessed apnea in their patients using polysomnography and we merely asked patients and their visitors about the occurrence of apnea during their night sleep. In Nicholl et al. study, 51% of the patients with the chronic kidney disease had experienced sleep apnea syndrome. The mean neck base circumference was 43.3 ± 4.5 in patients with apnea. They found a meaningful relation between the neck base circumference and the incidence of sleep apnea syndrome (25). The prevalence of the sleep apnea syndrome reported in previous studies ranges between 11.8% and 73.5% (2, 4, 10, 20, 26). In our study, 23.19% of the patients had experienced sleep apnea syndrome. This difference between the estimation in different studies could be due to difference in evaluation method, as discussed earlier.

The prevalence of loud snoring reported in previous studies ranges between 4.7% and 50.3% (2, 4, 10, 20). We found this in 45% of our study population. Since the evaluation of snoring is highly dependent on the patients' and their visitors' reports, the difference between the results of these studies could be explained.

Consistent with our results, some researchers have found no relationship between the number of dialysis sessions and quality of sleep in these patients (4, 10). However, Cengic et al. observed that more weekly dialysis sessions were related to a lower quality of sleep (4).

Celik et al. found that the quality of dialysis was an independent predictor for the PSQI score (9), while we, Trbojevic-Stankovic et al., (15), Bastos et al., (16) and Einollahi et al. (23) found no relation between the quality of dialysis and the quality of sleep.

Merlino et al. and Baraz et al. investigated the effect of sleep medication on the quality of sleep in the hemodialysis patients and observed no significant effect (2, 11). In our study, those patients who had not used sleep medications in the last month had a better quality of sleep than those who used them.

Sabet et al. found a relationship between confusion and/or delirium, and a lower quality of sleep in their patients (10). Cengic et al. found this problem in 6.8% of their patients (4). It was seen in 32.9% of our study population and had a meaningful correlation with a lower quality of sleep.

Cengic et al. (4) and Merlino et al. (2) reported nightmares in 25% and 13.3% of their study population, respec-

tively. In our study, 51.2% of the patients had experienced different sorts and degrees of nightmare.

This study had several limitations. First, this was a subjective, observational cross-sectional study and we cannot be sure about any cause and effect relationships between the studied parameters and quality of sleep. Second, we did not perform a polysomnographic study as a subjective test for assessing sleep problems in our patients who have a poor quality of sleep. Third, we did not have a control group. Future studies should consider these limitations.

5.1. Conclusion

Low sleep quality and quantity impact the persons' quality of life. However, despite their frequency and importance, such conditions often go unnoticed, since all patients do not clearly manifest fully expressed symptoms. Therefore, sleep disturbances in hemodialysis patients should be considered by healthcare providers as one of the challenging problems and early detection and intervention to improve the quality of sleep should be necessary. Further studies are required for better understanding of risk factors associated with a poor quality of sleep to find possible treatments for these patients.

Acknowledgments

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