Comparison of Sleep Quality and Dialysis Adequacy of Patients Undergoing Hemodialysis

Banu Terzi¹, Eylem Topbaş², Hatice Çavuş Ergül³

¹Fundamentals of Nursing Department, Faculty of Nursing, Akdeniz University, Antalya, Turkey,
²Faculty of Health Sciences, Amasya University, Amasya, Turkey,
³Hemodialysis Department, Amasya University Sabuncuoğlu Şerefeedin Training and Research Hospital, Amasya, Turkey

ABSTRACT. Sleep, as one of the key life activities, is an important indicator of the quality of life. Chronic kidney disease, with a high prevalence, is a serious condition that can deteriorate the sleep quality of patients. This study was carried out to investigate the correlation between sleep quality and dialysis adequacy in hemodialysis (HD) patients on a population and sample consisting of 50 patients receiving HD treatment at a training and research hospital in Amasya. Data were collected using “Patient Information Form,” “Pittsburgh Sleep Quality Index (PSQI),” and “Good Dialysis Index (GDI).” Sleep patterns of patients during HD were observed and recorded for three weeks. The average age was 64.46 years (minimum: 22, maximum: 86; standard deviation: 14.612), 56% (n = 28) are women, 64% (n = 32) are married, 82% (n = 41) have PSQI score ≥5, and 60% were found to have 30 min weekly average sleep duration during HD sessions. A statistically significant relationship was found between the overall GDI scores and the overall Pittsburgh Sleep Quality Index (PSQI) scores of the patients (P <0.05). PSQI scores of patients increase with increasing GDI scores. Good dialysis adequacy improves the sleep quality of patients.

Introduction

Chronic kidney disease (CKD), which is a disease with high prevalence, is an important health problem which deteriorates the sleep quality of patients. In Turek, Ricardo, and Lash’s laboratory and epidemiologic studies, it is emphasized that inadequate sleep and bad sleep quality causes three important risk factors for CKD, i.e., hypertension, type 2 diabetes, and obesity, and that it critically worsens the prognosis of the disease. For this reason, sleep disorders are thought to be a potent risk factor in the progression of CKD.

Among predialysis patients with CKD, it was reported that 77.8% of patients have poor sleep quality. Hemodialysis (HD), a frequently used treatment option in CKD, prolongs the life span of individuals with CKD. Nevertheless,
in the studies conducted with HD patients and patients with chronic renal disease, it has been reported that sleep disorders are more frequent in HD patients. It is reported that this is related to skipped dialysis dosage and shortened duration of dialysis.\(^3\)

In literature, it is stated that sleep disorders are encountered in varying rates with HD patients: 90.86\(^%\),\(^4\) 83.7\(^%\),\(^2\) 73.72\(^%\),\(^5\) 63.4\(^%\),\(^6\) and 57.1\(^%\).\(^7\)

Limitations in life activities, metabolic changes due to the disease, pain, limitations in nutrition, dyspnea, fatigue, cramps, old age, hypocapnia associated with chronic metabolic acidosis, use of acetate dialysis, peripheral neuropathy affecting the upper respiratory tract nerves, and some emotional problems cause sleep disorders in HD patients.\(^8\) It is stated that sleep problems in HD patients lead to problems such as fatigue, exhaustion, concentration difficulty, decrease in pain threshold, nervousness, anxiety, and depression by causing adverse effects on self-care ability and quality of life of individuals.\(^9\) It is also stated that it triggers inflammatory diseases such as autoimmune, infectious, and cardiovascular disease and diabetes.\(^1,7\)

Providing dialysis efficiency not only improves the quality of life of the individual but also contributes to the resolution of sleep problems. In uremic patients, deep sleep periods are shortened and total sleep times are reduced.\(^10\) For this reason, the provision of dialysis efficiency is one of the primary tasks of the dialysis nurses.

Studies are underway to reduce the morbidity and mortality rates by providing dialysis adequacy with developing dialysis technology. Increasing the dialysis clearance of HD patients is not seen as the main target.\(^7\) In order to increase the quality of life of the patients, it is aimed that the basic physiological requirements such as nutrition and sleep should be met and restored with all aspects of health.\(^7\) Nurses have to consider sleep activity when considering the individual as a whole.

In literature, no studies investigating the relation between the patients’ sleep quality and Good Dialysis Index (GDI) were seen. For this reason, in our study, it is aimed to evaluate the comparison of sleep quality and dialysis adequacy.

**Material and Methods**

**Object and type of the study**
The aim of the descriptive and cross-sectional study is to compare the sleep quality and dialysis adequacy on HD patients.

**Universe and sample of the study**
The sample of the study consisted of all the patients who were treated in the HD unit of an education and research hospital in Amasya (\(n = 50\)).

**Data collection tools**
Data collection tools consist of three parts:

1. **Patient Information Form:** The form prepared by the researchers in the context of the related literature\(^4,8,10\) includes a total of 17 questions about sociodemographic information such as age, gender, marital status, educational status, and the status of HD treatment such as medical diagnosis, presence of a chronic disease, frequency of HD/week, duration of HD, vital signs during HD treatment, and complications during HD.

2. **Pittsburgh Sleep Quality Index (PSQI):** PSQI is a self-report scale assessing sleep quality and deterioration in a one-month span and it was developed by Buysse et al,\(^11\) and the Turkish validity and reliability studies were conducted by Agargün et al.\(^12\) The scale consists of 24 questions and 7 subdimensions assessing “subjective sleep quality,” “sleep latency,” “sleep duration,” “usual sleep activity,” “sleep disorder,” “sleeping pill use,” and “daytime dysfunction.” These seven subdimensions are subjective sleep quality (component 1), sleep latency (component 2), sleep duration (component 3), usual sleep activity (component 4), sleep disorder (component 5), sleeping pill use (component 6), and daytime dysfunction.
The sum of the seven component scores gives the total PSQI score. The components indicated by a single question score are component 1 (question 6), component 3 (question 4), and component 6 (question 7). Component 2 score is obtained by the sum of questions 2 and 5, and component 4 score is obtained by the sum of questions 8 and 9. The response of each is scored between 0 and 3 according to symptom frequency. The total score has a value between 0 and 21. The scale does not indicate if there is a sleep disorder or the prevalence of sleep disorders. The higher the total scale score, the worse the sleep quality. However, it is stated that if the total score is 5 or more, it indicates poor sleep quality. In other words, the total sleep quality is classified as good (0–4 points) and poor sleep quality (5–21 points). The scores of different groups are interpreted by comparing them.

3. **GDI**: The form developed by Agar\(^{13}\) consists of four parts indicating the effectiveness of HD treatment (patient-oriented questions – 6 parts, HD process-oriented questions – 6 parts, laboratory results showing the effectiveness of HD treatment – 6 parts, and medication – 2 parts) and a total of 20 items. The highest score that can be taken from the index is 20; “16–20 points: HD treatment is effective,” “10–16: Efficiency of HD treatment should be improved,” and “<10: HD treatment is inadequate.” It was used in this study to assess the effectiveness of HD treatment since the form is thought to be effective in demonstrating the effectiveness of HD treatment and used frequently in a clinic, especially as a part of medical records of HD patients.

**Data collection process**

These forms were completed only once at the beginning of the research by face-to-face interviews with patients undergoing HD. Laboratory parameters in GDI were obtained from the laboratory inspection forms of the patients, and life findings were obtained from the nurse observation form, which were recorded every session. Patients were also monitored during HD sessions for three weeks (a total of 9 sessions); the duration of sleep during each HD treatment session was recorded.

**Ethical considerations**

The Helsinki Declaration was abided by throughout the study. Written consent was obtained from the patients after informing them about the purpose of the study and what was expected from them. They were informed that they were free to participate or not, they could quit anytime they wanted, and the results would be published anonymously. Written permission was obtained from the General Secretary of the Union of Public Hospitals of Turkey, where the hospital data collected were bounded to, and the local ethics committee of the university (26.05.2017/07) where the research was conducted.

**Limitations of the research**

The limitations of the research were evaluating PSQI and GDI only once in the beginning of the study.

**Statistical Analysis**

The data obtained from the questionnaire were analyzed using IBM SPSS Statistics for Windows version 21.0 (IBM Corp., Armonk, NY, USA). In data analysis, ordinal variables were evaluated as arithmetic mean and standard deviation (SD), minimum, and maximum and nominal variables were evaluated as frequency and percentage; paired samples test and paired samples correlations were used for determining the relation between ordinal variables. Moreover, the Durbin–Watson statistic method was used for autocorrelation in the residuals from a statistical regression analysis.

**Results**

The results of the research were examined in four parts:
Patients’ characteristics associated with sociodemographic, disease, and HD treatment according to scores of Pittsburgh Sleep Quality Scale and GDI

When the sociodemographic characteristics of the patients receiving HD treatment, it was detected that the average age was 64.46 (min: 22–max: 86 years, SD = 14.61), 56% of the patients were woman (n = 28), 64% of them were married (n = 32); 44% of them were primary school graduate (n = 22), and 56% of them were homemaker (n = 28). When the patients were evaluated according to the characteristics of the disease, it was found that 72% of the patients had additional chronic disease (n = 36) and 66% of those who have additional chronic disease were diabetes or/and hypertension patients (n = 33) (Table 1).

When the characteristics about the HD treatment were investigated, it was found that 96% of the patients attended HD session three times a week (n = 47) (Table 1). By comparing patients’ sociodemographic characteristics with PSQI and GDI average scores, it was detected that GDI average scores of the patients aged 20–45 years were significantly higher than other age groups (P <0.05), and there was a statistically significant relationship between average of age and GDI average scores (P <0.05). It was also detected that there were statistically significant differences between average scores of PSQI and GDI; GDI average scores of males were found significantly higher than females (P <0.01), and PSQI average scores of males were found significantly lower than females (P <0.05). Furthermore, statistically significant differences were detected between professional status of patients and average scores of PSQI and GDI (P <0.01) (Table 1).

Patients’ characteristics related to sleep activity according to scores of Pittsburgh Sleep Quality Scale and GDI

When the characteristics of the patients’ sleep activity and the total scores of the PSQI were examined, 60% of the patients (n = 30) were found to have irregular sleep habit in their normal lives, and only 6% (n = 3) of the patients were using sleep aids. When the average sleep duration of patients was examined during HD sessions, it was found that at the 1st week, 40% (n = 20) had an average of 60 min, 56% (n = 28) at the 2nd week had an average of 30 min, and 60% at the 3rd week (n = 30) had an average of 30 min. When the patients’ total scores according to PSQI were evaluated, it was found that 82% of the patients scored 5 or more points (n = 41) and had poor sleep quality (Table 2).

It was detected that patients with regular sleep patterns had significantly higher GDI average scores (P <0.05) and significantly lower PSQI average scores (P <0.01) than patients with irregular sleep (Table 2). Patients who do not use facilitators for sleeping had significantly higher GDI average scores (P <0.05) and significantly lower PSQI average scores (P <0.01) (Table 2).

By comparing sleep duration of the patients for three weeks during HD sessions with average scores of GDI and PSQI, it was found that patients who sleep 90 min and above in the 3rd week of HD session had significantly higher GDI average scores (P <0.05) (Table 2). Although not statistically significant, GDI average scores of the patients who scored <5 on PSQI were found higher than the patients who scored ≥5 on PSQI and those patients had statistically significant lower average scores on PSQI (P <0.01) (Table 2).

Comparison of PSQI and GDI scores of patients

When patients’ total scores obtained from PSQI and GDI were compared, it was detected that there was a statistically negative significant relation between them (P<0.05) (Table 3).

Multiple regression analysis results on the effect of age, gender, child, and occupational variables on GDI scores

By analyzing the effects of age group, gender, having a child and professional status on GDI, it was found that age group and gender had statistically significant effects on GDI scores (P <0.05) (Table 4).
Discussion

According to the results of our research in which we compared the efficiency of dialysis and quality of sleep of the HD patients, while it was detected that the efficiency of dialysis was significantly higher in patients aged 20–45, a positive relationship was also detected between the average of age and the quality of sleep of patients.

It is known that sleep quality of individuals is negatively affected and various sleep disorders...
Table 2. Patients’ characteristics related to sleep activity according to scores of Pittsburgh Sleep Quality Scale and Good Dialysis Index (n=50).

| Characteristics related to sleep activity | N (%) | GDI Mean±SD | PSQI Mean±SD |
|------------------------------------------|-------|-------------|--------------|
| Sleep habit                              |       |             |              |
| Regular                                  | 20 (40) | 15.15±2.13 | 6.20±3.35 |
| Irregular                                | 30 (60) | 13.60±1.91 | 11.60±3.77 |
|                                         |        | t=2.686; P=0.010 | t=−5.186; P=0.000 |
| Use of sleep aids                        |       |             |              |
| Yes                                      | 3 (6)  | 11.33±0.58  | 17.67±1.16 |
| No                                       | 47 (94) | 14.40±2.05 | 8.91±4.05 |
|                                         |        | t=−2.565; P=0.013 | t=3.698; P=0.001 |
| Sleep duration during HD 1st week        |       |             |              |
| No sleep                                 | 5 (10) | 14.00±2.83  | 11.20±6.18 |
| 30 min                                   | 16 (32) | 14.31±1.99  | 8.94±3.21 |
| 60 min                                   | 20 (40) | 14.20±2.14  | 9.75±4.85 |
| 90 min and above                         | 9 (18) | 14.22±2.28  | 8.67±4.90 |
|                                         |        | F=0.27; P=0.994 | F=0.434; P=0.730 |
| Sleep duration during HD 2nd week         |       |             |              |
| No sleep                                 | 14 (28) | 14.64±2.44  | 9.64±4.45 |
| 30 min                                   | 28 (56) | 14.04±1.92  | 9.32±3.24 |
| 60 min                                   | 3 (6)  | 13.33±2.52  | 11.00±7.94 |
| 90 min and above                         | 5 (10) | 14.60±2.51  | 8.60±4.83 |
|                                         |        | F=0.468; P=0.706 | F=0.188; P=0.904 |
| Sleep duration during HD 3rd week         |       |             |              |
| No sleep                                 | 9 (18) | 14.89±2.71  | 9.44±5.27 |
| 30 min                                   | 30 (60) | 13.97±1.77  | 9.67±4.20 |
| 60 min                                   | 5 (10) | 12.60±2.30  | 9.00±5.96 |
| 90 min and above                         | 6 (12) | 15.83±1.72  | 8.67±4.32 |
|                                         |        | F=2.862; P=0.047* | F=0.097; P=0.962 |
| Pittsburgh Sleep Quality Scale total score |     |             |              |
| <5 score                                 | 9 (18) | 15.00±1.87  | 3.00±1.00 |
| ≥5 score                                 | 41 (82) | 14.05±2.16  | 10.85±3.58 |
|                                         |        | t=1.224; P=0.227 | t=−12.079; P=0.000 |

GDI: Good Dialysis Index, PSQI: Pittsburgh Sleep Quality Index, SD: Standard deviation, HD: Hemodialysis, *c<d.

Table 3. Comparison of the patients’ scores of Pittsburgh Sleep Quality Scale and Good Dialysis Index (n=50).

| Scales                  | Mean±SD (Min–Max) | t*, P   | r**, P |
|-------------------------|-------------------|---------|--------|
| GDI                     | 14.22±2.12 (11–18)| t=−6.001 | R=−0.388 |
| PSQI                    | 9.44±4.46 (1–19)  | P=0.000 | P=0.005 |

GDI: Good Dialysis Index, PSQI: Pittsburgh Sleep Quality Index, SD: Standard deviation, *Paired samples test, **Pearson correlations.
are observed during HD treatment. This situation is connected to various reasons. Changes in the renin-angiotensin-aldosterone system during CKD, sympathetic nervous system activation, and depression decrease sleep quality. When patients in our study group are asked to evaluate their sleep activities in normal life, 60% of the patients (n=30) evaluated their sleep activities as irregular, and when the sleep activities of patients were evaluated by PSQI, it was detected that 82% of them had poor sleep quality in line with literature according to PSQI. Sleep problems increase the severity of the disease such as diabetes mellitus, hypertension, and increased vascular endothelial resistance by causing many adverse effects. Therefore, deterioration in sleep activity should not be considered as a problem only when the patient identifies it. Sleep is an important life activity that must be constantly questioned by nurses. For this reason, we think that nurses should take an in-depth look at sleep activity during each dialysis session.

In this study, HD patients were observed for three weeks during HD sessions for their sleep durations. It was detected that patients who sleep 90 min and above in the 3rd week of HD session had significantly higher GDI average scores. Furthermore, it was found that patients who scored <5 on PSQI also had significantly low average total scores on PSQI. In other words, it could be stated that these patients have a quality sleep activity. This suggests that it is necessary to regulate the environment in order to contribute to the sleep patterns of the patients during dialysis. Sadeghi et al stated that the sleep quality of patients increased by 55% with the continuous care model, and they applied in HD patients. In another study, it was reported that trainings toward self-care resulted in an increase in sleep quality of HD patients. On the other hand, elimination of sleep problems is also an indication of the increase in quality of life.

A statistically significant, inverse difference and relationship was found between the GDI and PSQI scores of the HD patients included in the sample of our study. Patients with decent dialysis efficiency had lower sleep quality scores which indicate that these patients’ sleep quality is at high levels. In literature, no studies were found which directly compare GDI and PSQI scores. While the dialysis efficacy depends, in part, on the patient’s dialysis dose, adequacy should not depend solely on the realization of a specific dose target. In literature, it was discussed that Kt/V, albumin, triglycerides, calcium, phosphorus, hemoglobin, other accompanying chronic diseases and pain were to be handled one by one instead of all the parameters included in the GDI. In our study, the average total score of the patients was 14.22 ± 2.12 (11–18). This result suggests that the efficacy of dialysis treatment should be improved. GDI does not only include Kt/V as a dialysis efficacy indicator but also consider parameters such as hyperphosphatemias, parathyroid hormone, albumin, C-reactive protein, use of blood pressure and phosphorus-binding drugs, working life of the individual, pain, cramp during dialysis, etc., nutrition, liquid restriction, and the presence of arteriovenous fistula, and for this reason, it can be widely used to guide nurses and physicians in clinical practice.

| Variables                          | B    | SE   | β    | t; P   |
|------------------------------------|------|------|------|--------|
| Good Dialysis Index score          | 4.070| 2.269| 1.794| 0.080  |
| Age categories                     | 1.469| 0.490| 0.430| 3.001; 0.004 |
| Gender                             | 4.983| 2.271| 1.178| 2.195; 0.033 |
| Status of having children          | 1.875| 0.978| 0.290| 1.917; 0.062 |
| Occupational status                | −1.153| 0.794| −0.776| −1.451; 0.154 |

R=0.631; R²=0.398; AR²=0.344; P<0.001; Durbin–Watson=2.194; F=7.426 and P<0.001, SE: Standard error.
Our research indicated that patients’ PSQI total average scores increased with the decrease in their GDI total average scores. In other words, patients who had good dialysis adequacy also had good sleep quality. The results indicate that there is a significant relationship between GDI and sleep quality.

When investigating researches on the relationship between sleep activity and dialysis adequacy, it is stated that there is a significant correlation between pain level and Kt/V, hemoglobin and phosphorus, and in addition to this between sleep disorders and thyroid hormones, triglycerides, and cholesterol levels. It is also stated that there is a negative relationship between sleep quality and hypocalcemia and hyperphosphatemia.

It is emphasized that there is a positive correlation between the increase in blood–urea–nitrogen levels and the severity of sleep disturbance. For the determination of dialysis adequacy, besides urea clearance, parameters such as uremia symptoms, patient’s clinical status, blood pressure, biochemical markers of uremia and nutrition, dialysis clearance are taken into consideration. Objective assessment (volume/blood pressure control, blood pH, phosphate level, serum albumin level, nutritional status, etc.) is also considered in addition to subjective assessment (uremia symptoms such as nausea, fatigue, and pruritus) for the measurement of the HD efficacy.

Our study detected that age and gender had positive effects on GDI scores. Characteristics such as age and gender are factors determining expectancy of life, and these factors can also affect the efficiency of dialysis. On the other hand, the efficiency of HD is a subject which requires a complex evaluation and analysis.

GDI consists of treatment-oriented and laboratory-focused objective categories in which these parameters are included in the subclasses instead of being evaluated individually for each parameter showing dialysis adequacy. In addition, patient-oriented questions are also included in the index. For this reason, GDI guides both clinicians and nurses both in performing the nursing care plan effectively and in performing the treatment at an optimum level by assessing HD patients in various objective and subjective ways. More researches about PSQI and GDI with different groups and more samples are needed.

**Conclusion**

This study showed that there is a negative and coherent relationship between PSQI and GDI and detected that sleep quality deteriorates with the decrease in dialysis efficacy. Sleep activity during HD treatment is a basic requirement to be addressed. In this direction, it is suggested that the nurses should continuously evaluate the patient’s clinical sleeping problems, act in the purpose of increasing the sleep quality, and use objective measurement tools and methods to identify sleep disorders.

**Acknowledgments**

We would like to thank the HD patients and the nurses who work in HD unit.

**Conflict of interest:** None declared.

This study was presented as oral presentation at EDTNA/ERCA Conference, 9-12 September 2017, Krakow, Poland.

**References**

1. Turek NF, Ricardo AC, Lash JP. Sleep disturbances as nontraditional risk factors for development and progression of CKD: Review of the evidence. Am J Kidney Dis 2012; 60:823-33.
2. Sadeghi H, Forouzi AM, Haghdust AA, Alizadeh MS. Effect of implementing continuous care model on sleep quality of hemodialysis patients. Iran J Crit Care Nurs 2010;3:13-8.
3. Agarwal R, Light RP. Sleep and activity in chronic kidney disease: A longitudinal study. Clin J Am Soc Nephrol 2011;6:1258-65.
4. Mehrabi S, Sarihani S, Roozbeh J. Sleep quality in patients undergoing long-term hemodialysis using the Pittsburgh sleep quality
5. Abassi MR, Safavi A, Haghverdi M, Saedi B. Sleep disorders in ESRD patients undergoing hemodialysis. Acta Med Iran 2016;54:176-84.

6. Einollahi B, Motalebi M, Rostami Z, Nemati E, Salesi M. Sleep quality among Iranian hemodialysis patients: a multicenter study. Nephrourol Mon 2015;7:e23849.

7. Chang SY, Yang TC. Sleep quality and associated factors in hemodialysis patients. Acta Nephrol 2011;25:97-104.

8. Uzun S, Kara B, Iscan B. Sleep disorders in hemodialysis patients with chronic renal failure. Turk Neph Dial Transpl 2003;2:61-6.

9. Tel H, Tel H, Esmek M. Quality of sleep in hemodialysis patients. Dial Transpl 2007;36:479-84.

10. Sert F, Demir BA, Bora I, Yildiz A, Ocakoglu G, Ersoy A. The research of sleep disorders and their effects on quality of life in patients with chronic renal failure and renal transplant. Türk Uyku Tibbi Derg 2015;1:15-9.

11. Buysse DJ, Reynolds CF 3rd, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: A new instrument for psychiatric practice and research. Psychiatr Res 1989;28:193-213.

12. Agargün MY, Kara H, Anlar O. The validity and reliability of the Pittsburgh Sleep Quality Index. Turk Psikiyatri Derg 1996;7:107-11.

13. Agar J. Good Dialysis Index; 2012. Available From: http://www-nocturndialysis.org/good_dialysis_form.htm. [Last accessed on 2017 Apr 03].

14. Maung S, Sara AE, Cohen D, Chapman C, Saggi S, Cukor D. Sleep disturbance and depressive affect in patients treated with haemodialysis. J Ren Care 2017;43:60-6.

15. Sabry AA, Abo-Zenah H, Wafa E, et al. Sleep disorders in hemodialysis patients. Saudi J Kidney Dis Transpl 2010;21:300-5.

16. Rahimi F, Gharib A, Beyramijam M, Naseri O. Effect of self-care education on self efficacy in patients undergoing hemodialysis. Life Sci J 2014;11:136-40.

17. Harris D, Elder G, Kairaitis L, Rangan G. Basic Clinical Dialysis. Australia: McGraw Hill Education; 2008.

Date of manuscript receipt: 6 September 2018.
Date of revised copy receipt: 8 July 2019.
Date of final acceptance: 8 July 2019.