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ORIGINAL RESEARCH

Sleep quality, depression, and quality of life in elderly hemodialysis patients

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Kultigin Turkmen[1]
Fatih Mehmet Erdur[1]
Ibrahim Guney[2]
Abduzhappar Gaipov[1]
Faruk Turgut[3]
Lutfullah Altintepe[2]
Mustafa Saglam[1]
Halil Zeki Tonbul[1]
Emaad M Abdel-Rahman[4]

[1]Division of Nephrology, Meram School of Medicine, Necmettin Erbakan University, Meram, Konya, Turkey; [2]Division of Nephrology, Meram Research and Training Hospital, Meram, Konya, Turkey; [3]Division of Nephrology, Iskenderun State Hospital, Iskenderun, Hatay, Turkey; [4]Division of Nephrology, University of Virginia Health System, Charlottesville, VA, USA

Objective: Both the incidence and the prevalence of end-stage renal disease (ESRD) in elderly patients are increasing worldwide. Elderly ESRD patients have been found to be more prone to depression than the general population. There are many studies that have addressed the relationship between sleep quality (SQ), depression, and health related quality of life (HRQoL) in ESRD patients, but previous studies have not confirmed the association in elderly hemodialysis (HD) patients. Therefore, the aim of the present study was to demonstrate this relationship in elderly HD patients.

Patients and methods: Sixty-three elderly HD patients (32 females and 31 males aged between 65 and 89 years) were included in this cross-sectional study. A modified Post-Sleep Inventory (PSI), the Medical Outcomes Study 36-item short form health survey, and the Beck Depression Inventory (BDI) were applied.

Results: The prevalence of poor sleepers (those with a PSI total sleep score [PSI-4 score] of 4 or higher) was 71% (45/63), and the prevalence of depression was 25% (16/63). Of the 45 poor sleepers, 15 had depression, defined as a BDI score of 17 or higher. Poor sleepers had a significantly higher rate of diabetes mellitus ($P = 0.03$), significantly higher total BDI scores, and lower Physical Component Scale scores (ie, lower HRQoL) than good sleepers. The PSI-4 score correlated negatively with Physical Component Scale ($r = -0.500$, $P < 0.001$) and Mental Component Scale scores ($r = -0.527$, $P < 0.001$) and it correlated positively with the BDI score ($r = 0.606$, $P < 0.001$). In multivariate analysis, independent variables of PSI-4 score were BDI score (beta value [β] = 0.350, $P < 0.001$), Mental Component Scale score (β = –0.291, $P < 0.001$), and age (β = 0.114, $P = 0.035$).

Conclusion: Poor SQ is a very common issue and is associated with both depression and lower HRQoL in elderly HD patients.

Keywords: health-related quality of life, end-stage renal disease, poor sleep quality, Post-Sleep Inventory, Beck Depression Inventory

Introduction

The prevalence of depression in elderly patients (those aged 65 years or older) may be as high as 40% in hospital and nursing home settings and 8%–15% in community settings.[1] Depression is a major contributor to health care costs associated with older populations, and it is projected to be the leading cause of disease burden in older populations by the year 2020.[2,3] Both the incidence and the prevalence of end-stage renal disease (ESRD) in elderly patients are also increasing worldwide.[4,5] Elderly ESRD patients, especially those with vascular risk factors, have been found to be more prone to depression than the general population.[6] In a meta-analysis, both the presence of chronic disease and poor self-reported health status were found to be risk

Correspondence: Kultigin Turkmen
Department of Nephrology, Meram School of Medicine, Necmettin Erbakan University, Meram, Konya, 42090, Turkey
Tel +90 538 492 7877 (mobile)
Email mdkt2010@yahoo.com

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factors for increased depression among the elderly, with poor self-reported health appearing to be more closely associated with depression than the presence of chronic disease.[7] The prognosis of these depressive states is poor. Clinical depression is a common psychiatric disorder and is associated with increased morbidity and mortality in ESRD patients.[8]

Poor sleep quality (SQ) is not uncommon in hemodialysis (HD) patients; the prevalence of poor SQ in this population has been shown to range from 41% to 83%.[9,10] Previous studies have shown that poor SQ in HD patients is associated with female sex, advanced age, depression, cardiovascular disease, dialysis vintage, poor dialysis quality, and poor health-related quality of life (HRQoL).[11,12,13] It is widely accepted that HRQoL is an important outcome of health care, both in the general population and in ESRD patients.[14] Also, as stated earlier, depressive mood has been found to be associated with morbidity and mortality in ESRD patients.[15,16] There are many studies that have addressed the relationship between SQ, depression, and HRQoL in the general population;[17–20] however, the data about SQ, depression, and HRQoL in elderly HD patients are limited. Kutner et al[21] reported that older dialysis patients are significantly prone to restless sleep. Because SQ is a modifiable risk factor and there are implications that improving SQ can also cure depression and improve HRQoL, the exact relationship between these issues should be examined in elderly HD patients. Therefore, the aim of this study was to investigate the association between SQ, depression, HRQoL, and independent variables of SQ in elderly HD patients.

Patients and methods

The present study is a subgroup analysis of a previous study by the authors.[11] A total of 233 ESRD patients receiving HD three times weekly over a period of more than 3 months at five centers in Konya, Turkey, between February and June 2006 were evaluated in this cross-sectional study. Patients aged 65 years or older were accepted as "elderly" patients. A review of medical records, including information on age, sex, weight, height, duration of renal replacement therapy, medications, and primary cause of ESRD, was undertaken. Exclusion criteria included (1) severe cognitive impairment, (2) inability to answer the questionnaire, (3) treatment with a sleep medication, (4) presence of chronic pain, (5) presence of chronic obstructive pulmonary disease, (6) presence of psychosis, (7) a past history of sleep disorders including dyssomnias (frequent awakening, hypervigilance, etc) and parasomnias (sleepwalking, bruxism, etc), (8) a past history of sleep apnea syndrome, and (9) patients younger than 65 years of age. Of the 233 ESRD patients evaluated, 63 elderly patients (aged between 65 and 89 years) who were willing to participate and who met the inclusion criteria were included in the study.

HD patients received dialysis three times a week for 4 hours each time. Patients were dialyzed with a standard bicarbonate-containing dialysate bath, using a biocompatible HD membrane (Fresenius Polysulfone®, FX-80 series; Fresenius Medical Care, Bad Homburg, Germany). Dialysate flow rates were set at 500 mL per minute and blood flow rates were kept between 250 and 300 mL per minute. Both the systolic and the diastolic blood pressures of patients were measured in the upright sitting position after 5 minutes or more of rest, using an Erka sphygmomanometer [PMS (Instruments) Ltd, Berkshire, UK] with an appropriate cuff size. Two readings were recorded for each individual, and the mean value of these two readings was defined as the blood pressure. Patients with a systolic blood pressure greater than 140 mmHg and a diastolic blood pressure of 90 mmHg or those who were already on antihypertensive treatment were assumed to be hypertensive.

In patients receiving HD, venous blood samples for biochemical analyses were drawn after an overnight fast before the midweek HD session. All biochemical analyses – including glucose, creatinine, total cholesterol, low-density lipoprotein cholesterol, high-density lipoprotein cholesterol, and plasma triglyceride concentrations – were performed using an oxidase-based technique and were measured by a Roche/Hitachi Modular System (Roche Diagnostics GmbH, Mannheim, Germany) in the Central Biochemistry Laboratory of Selcuk University, Konya, Turkey.

The institutional medical ethics committee of Selçuk University, Konya, Turkey, approved the study protocol, and written informed consent was obtained from all subjects included in the study.

Evaluation of SQ

To evaluate SQ, a modified Post-Sleep Inventory (PSI) was applied to all patients. The PSI was developed by Webb et al[22] to permit an adequate description of subjective responses to a preceding period of sleep. The PSI involves a questionnaire with three groups of opposing statements separated by an analog rating scale from 0 to 1. A score of 0 reflects a positive opinion about the patient's SQ, while a score of 1 reflects a negative opinion. The aim is to classify the patient's understanding about his or her SQ in terms of feelings at bedtime (PSI-1 score), quality of nocturnal sleep (PSI-2 score), and feelings at awakening (PSI-3 score). For

this study, a total sleep score (PSI-4 score) was calculated by adding the PSI-1, PSI-2, and PSI-3 scores for each patient. The PSI-4 score could indicate no sleep problems at all (0), or mild (1–3), moderate (4–6), severe (7–9), or very severe (10–12) sleep problems.

Evaluation of HRQoL

The Medical Outcomes Study 36-item short form health survey was used to evaluate HRQoL.[23] The test comprises 36 items, which are assigned to eight dimensions – namely, (1) physical functioning (ten items), (2) physical role functioning (four items), (3) bodily pain (two items), (4) general health status (five items), (5) vitality (four items), (6) social functioning (two items), (7) emotional role functioning (three items), and (8) mental health (five items). Each scale is scored within a range of 0–100 – the higher the score, the better the HRQoL indicated. While the first four items constitute the Physical Component Scale (PCS), the remaining four items constitute the Mental Component Scale (MCS). These two summary scales have been shown to adequately represent values of their individual scale components with 80% and 85% variability, respectively.[24] This scale has been validated and is commonly used in patients with ESRD.[25,26]

Evaluation of depression

Depression was assessed using the Beck Depression Inventory (BDI), which had been validated and is commonly used in patients with ESRD.[15,16] It has been reported that 85% of Western dialysis patients with BDI scores of 11 or higher meet the *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition, criteria for diagnosis of major depression.[15] In Hisli's[27] validation and reliability study in a Turkish population, a BDI score of 17 or higher was determined as the cutoff value for the diagnosis of depression. Depression was also defined as a BDI score of 17 or higher in the present study.[28]

Statistical analysis

All calculations were performed using a standard statistical software package (SPSS v 13.0 for Windows; SPSS Inc, Chicago, IL). The data are presented as the mean plus or minus the standard deviation, unless otherwise specified. The proportion of subjects with a PSI-4 score of 4 or higher determined the prevalence of poor sleepers. Student's *t*-test was used to compare the means of normally distributed variables and the Mann-Whitney U test was used for variables that were not normally distributed. Differences among categorical variables were analyzed using the chi-square test or the two-tailed Fisher's exact test as appropriate. Spearman correlation coefficients were used to examine associations between continuous variables. Multiple linear regression analysis with forward stepwise selection ($P = 0.05$) was performed to identify factors independently associated with the PSI-4 score. The level of significance (*P*-value) was 0.05 for all comparisons.

Results

The sociodemographic and clinical features of the patients in this study are shown in Table 1. The mean age of the patients was 70.5 ± 4.7 years and the mean dialysis vintage was 48.3 ± 35 months. The patients had a range of conditions: diabetic nephropathy (n = 19), chronic glomerulonephritis (n = 2), hypertensive nephropathy (n = 15), polycystic kidney disease (n = 2), chronic pyelonephritis (n = 5), and unknown (n = 20).

The mean and median PSI-4 scores were 6.4 ± 3.6 and 6.0 (range, 0–12), respectively. The prevalence of poor sleepers (defined as those having a PSI-4 score of 4 or higher) was 71% (45/63), and the prevalence of depression in elderly HD patients was 25% (16/63) in this study.

The sociodemographic characteristics of the good sleepers compared with the poor sleepers are shown in Table 2. Of the 45 poor sleepers in this study, 15 had depression (ie, a BDI score of 17 or higher); however, of the 18 good

Table 1 Sociodemographic and clinical characteristics of elderly hemodialysis patients (n = 63)

Parameter	Statistic
Age (years)*	70.5 ± 4.7
Gender (M/F)	31/32
Presence of DM [n (%)]	19 (30%)
Presence of hypertension [n (%)]	21 (33%)
Smoking [n (%)]	5 (8%)
Employed [n (%)]	9 (14%)
Dialysis vintage (months)*	48.3 ± 35
BMI (kg/m^2)*	23.9 ± 3.8
SBP (mmHg)*	129 ± 20
DBP (mmHg)*	74 ± 10
Serum albumin (g/dL)*	4.0 ± 0.4
Hemoglobin (g/dL)*	10.9 ± 1.2
Total cholesterol (mg/dL)*	182 ± 51
Triglycerides (mg/dL)*	172 ± 113
Calcium (mg/dL)*	8.9 ± 0.7
Phosphorus (mg/dL)*	4.5 ± 1.2
PTH (pg/mL)*	254 ± 240
Kt/V*	1.29 ± 0.2

Note: *Data presented as mean plus or minus standard deviation.
Abbreviations: BMI, body mass index; DBP, diastolic blood pressure; DM, diabetes mellitus; F, female; M, male; PTH, parathormon; SBP, systolic blood pressure.

Table 2 Sociodemographic and clinical characteristics of good versus poor sleepers

Parameter	Good sleepers (PSI-4 score < 4) (n = 18)	Poor sleepers (PSI-4 score ≥ 4) (n = 45)	*P*-value
Age (years)*	70.4 ± 5.0	70.6 ± 4.6	0.87
Female [n (%)]	8 (44%)	24 (53%)	0.58
Presence of DM [n (%)]	2 (11%)	17 (38%)	0.03
Presence of hypertension [n (%)]	9 (50%)	12 (27)	0.69
Presence of depression (BDI score ≥ 17) [n (%)]	1 (6%)	15 (33%)	0.02
Smoker [n (%)]	2 (11%)	3 (7%)	0.49
Employed [n (%)]	2 (11%)	7 (16%)	0.49
Dialysis vintage (months)*	59.7 ± 45.8	43.8 ± 29.1	0.18
BMI (kg/m^2)*	23.7 ± 3.7	24.0 ± 3.7	0.81
SBP (mmHg)*	132 ± 21	127 ± 19	0.44
DBP (mmHg)*	76 ± 11	73 ± 10	0.41
Serum albumin (g/dL)*	4.0 ± 0.4	4.1 ± 0.4	0.69
Hemoglobin (g/dL)*	10.1 ± 1.2	10.8 ± 1.1	0.32
Total cholesterol (mg/dL)*	171 ± 43	187 ± 54	0.28
Triglycerides (mg/dL)*	185 ± 186	167 ± 64	0.36
Calcium (mg/dL)*	8.8 ± 0.7	9.0 ± 0.7	0.35
Phosphorus (mg/dL)*	4.1 ± 1.2	4.7 ± 1.1	0.05
Kt/V*	1.33 ± 0.2	1.27 ± 0.2	0.32
Total BDI score*	10.4 ± 5.3	15.1 ± 8.9	0.03
PCS score*	56.9 ± 21.8	43.5 ± 22	0.04
MCS score*	66.7 ± 20.5	56 ± 23	0.06

Note: *Data presented as mean plus or minus standard deviation.
Abbreviations: BDI, Beck Depression Inventory; BMI, body mass index; DBP, diastolic blood pressure; DM, diabetes mellitus; MCS, Mental Component Scale; PCS, Physical Component Scale; PSI-4 score, Post-Sleep Inventory total sleep score; SBP, systolic blood pressure.

sleepers in this study, only one had depression. The presence of diabetes was significantly higher in poor sleepers than in good sleepers (38% and 11%, respectively; $P = 0.03$). The mean BDI, PCS, and MCS scores of good sleepers were 10.4 ± 5.3, 56.9 ± 21.8, and 66.7 ± 20.5, respectively. Poor sleepers had significantly higher total BDI scores and lower PCS scores than good sleepers (Table 2). A comparison of the mean MCS scores of poor sleepers and good sleepers shows 56 ± 23 and 66.7 ± 20.5, respectively ($P = 0.06$).

The correlations between the PSI-4 score and other continuous variables were studied. There was a significant negative correlation between PSI-4 score and PCS score ($r = -0.500$, $P < 0.001$) (Figure 1) and between PSI-4 score and MCS score ($r = -0.527$, $P < 0.001$) (Figure 2). Additionally, there was a positive correlation of PSI-4 score with BDI score ($r = 0.606$, $P < 0.001$) (Figure 3). In multivariate analysis, the independent variables of PSI-4 score were BDI score (beta value [β] = 0.350, $P < 0.001$), MCS score (β = –0.291, $P < 0.001$), and age (β = 0.114, $P = 0.035$) (Table 3). All of the dimensions of HRQoL were significantly higher in good sleepers than in poor sleepers (Table 4).

The authors also analyzed whether any correlation could be found between BDI score and smoking status, hypertension, and biochemical parameters (including parathormon, hemoglobin, and albumin levels). No relationship was found between PSI-4 score and smoking status, hypertension, and biochemical parameters. Also,

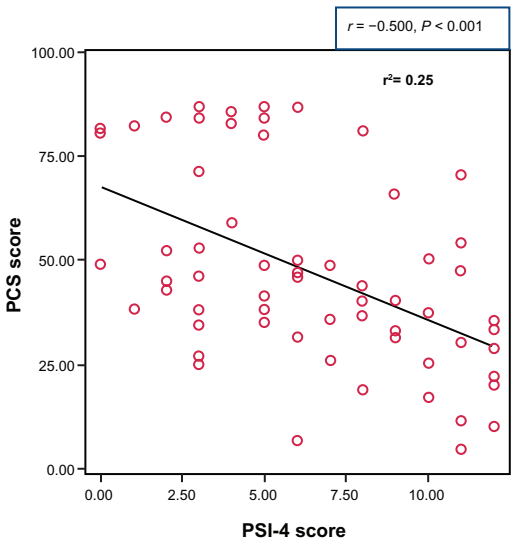

Figure 1 The correlation between Physical Component Scale (PCS) score and Post-Sleep Inventory total sleep score (PSI-4 score).

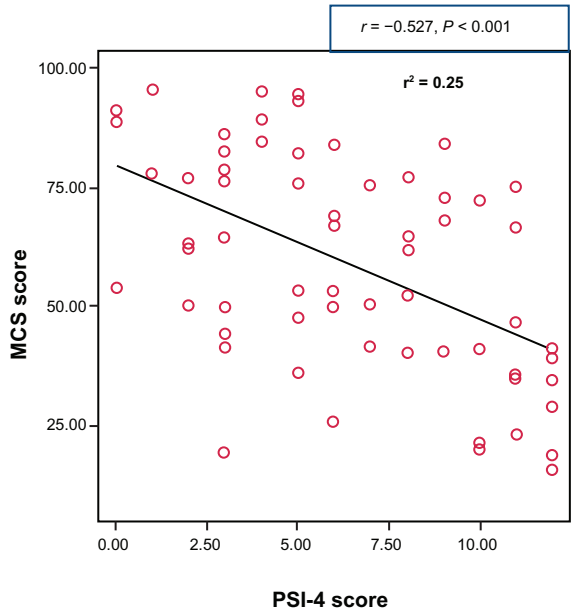

Figure 2 The correlation between Mental Component Scale (MCS) score and Post-Sleep Inventory total sleep score (PSI-4 score).

none of the dimensions of HRQoL were correlated with these parameters (data not shown).

Discussion

There were four main findings of this study. First, the authors found the prevalence of poor sleepers (those with a PSI-4 score of 4 or higher) to be 71% in the elderly HD patients. Second, poor sleepers had significantly higher total BDI scores and lower PCS scores than good sleepers. Third, there was a significant inverse relationship between the PSI-4 score and the PCS and MCS scores; however, a positive correlation was found between the PSI-4 score and the BDI score. Fourth, in the multivariate analysis, the independent variables of the PSI-4 score were found to be BDI score, MCS score, and age.

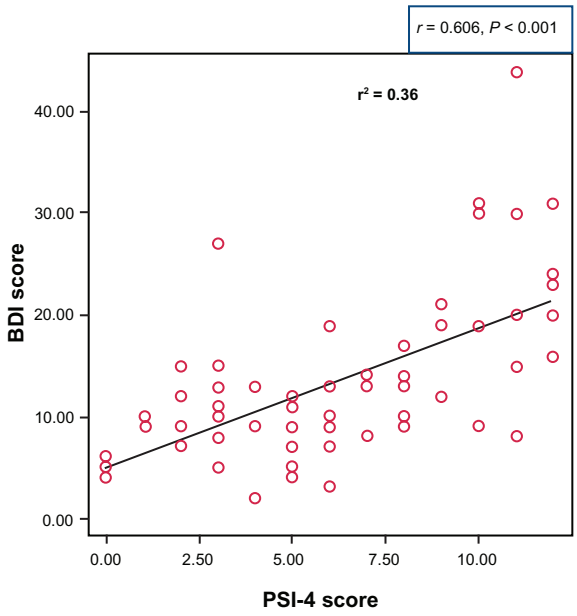

Figure 3 The correlation between Beck Depression Inventory (BDI) score and Post-Sleep Inventory total sleep score (PSI-4 score).

Table 3 Multiple linear regression models of independent variables of Post-Sleep Inventory total sleep score

Variable	Beta value	*P*-value	95% CI
BDI score	0.350	<0.001	0.086–0.193
MCS score	–0.291	<0.001	–0.068 to –0.025
Age	0.114	0.035	0.002–0.0051

Abbreviations: BDI, Beck Depression Inventory; CI, confidence interval; MCS, Mental Component Scale.

To the best of the authors' knowledge, this is the first study evaluating the relationship between SQ, depression, and HRQoL in elderly HD patients. In previous studies, the prevalence of poor SQ in HD patients has been reported as 41%–83%.[9–11] In the present study, the prevalence of poor SQ in elderly HD patients was found to be 71% (45/63). This result shows that the prevalence of poor SQ in elderly HD patients is high, as also seen in the general HD population.

In the present study, the prevalence of depression in elderly HD patients was found to be 25% (16/63), which is similar to that found in previous studies.[28,29] Several previous studies have reported a remarkable relationship between sleep alterations and depression in the general population. Elder et al[9] showed that depression was the only predictor of poor SQ. Along the same lines, Pai et al[10] also reported that poor sleepers had a higher BDI score than good sleepers and that this factor was one of the predictors of poor SQ in patients. Furthermore, Güney et al[30] concluded that poor SQ is a significant problem in peritoneal dialysis patients and suggested that regular assessment and management of SQ may be important for improvement of depression therapy in this population. Recently, Araujo et al[31] demonstrated that depressive symptoms are also independently associated with poor SQ in 400 patients on chronic HD. However, this relationship has been demonstrated less in elderly HD patients. In the present study, the authors observed that the elderly poor sleepers had a higher BDI score than the elderly good sleepers, which indicates that poor SQ is also associated with depression in the elderly HD population.

ESRD affects SQ at least by increasing the incidence of some specific sleep diseases.[32–34] Previous studies have

Table 4 Dimensions of health-related quality of life (HRQoL) among good and poor sleepers

Dimension of HRQoL	Good sleepers (PSI-4 score < 4)*	Poor sleepers (PSI-4 score ≥ 4)*	*P*-value
Mental health	73.5 ± 15.6	61.7 ± 21.2	<0.001
General health status	56.5 ± 23.2	41.8 ± 23.2	<0.001
Vitality	69.5 ± 19.4	54.7 ± 21.6	<0.001
Social functioning	90.5 ± 17.8	76.4 ± 28.4	<0.001
Physical role functioning	58.2 ± 46.4	42.9 ± 47.4	0.015
Emotional role functioning	63.7 ± 42	45.5 ± 44	0.002
Bodily pain	77.9 ± 26.5	69.6 ± 28.5	0.024
Physical functioning	64.2 ± 30.2	53.1 ± 32.7	0.01

Note: *Data presented as mean plus or minus standard deviation.
Abbreviation: PSI-4 score, Post-Sleep Inventory total sleep score.

found SQ to be associated with HRQoL in ESRD patients, and patients with good SQ have been found more likely to have high MCS and PCS scores (ie, good HRQoL).[9,11,35] Recently, Li et al[36] demonstrated that SQ is also affected by malnutrition and calcium-phosphorus product in continuous ambulatory peritoneal dialysis patients. In the present study, the poor sleepers had lower PCS scores (ie, lower HRQoL) than the good sleepers, and there was a significant negative correlation between PSI-4 score and both MCS and PCS scores. In multiple linear regression analysis, BDI score, MCS score, and age were found to be independent variables of the PSI-4 score. These results were consistent with results from the authors' previous study evaluating HD patients.[11]

There are conflicting results in the literature regarding the role of gender, smoking status, and comorbidity in sleep diseases in patients with ESRD. Some studies have reported that female sex has a negative impact on SQ,[9,10,12] while other studies have reported that SQ is not affected by gender.[30,35,37–39] Smoking cigarettes was also found to be associated with sleep diseases in some[9,38] but not all studies.[12,37] In the present study, only 8% of the patients were smokers and there was no relationship found between smoking and sleep diseases. This result could be attributed to the small sample size of elderly HD patients who smoked cigarettes, compared with the number of elderly HD patients who did not smoke.

Restless legs syndrome (RLS) has been found to be associated with diabetes in the general population.[40,41] Although some of the increased risk of RLS in diabetes appears to be mediated through the presence of peripheral neuropathy, the association between RLS and diabetes remains significant, even in patients without neuropathy.[42] Epidemiologic data are increasingly attesting to the negative impact of RLS upon health. RLS is significantly associated with diminished quality of life[43] and depression.[44] RLS was not explored in the patients in the present study; however, the rate of diabetes was higher in poor sleepers than in good sleepers (38% and 11%, respectively) – this might explain the poor quality of sleep noted in the patients in the present study.

Cognitive behavioral therapy (CBT) is a psychotherapeutic approach that addresses dysfunctional emotions, behaviors, and cognitions through a goal-oriented, systematic process. CBT has six phases: (1) assessment, (2) reconceptualization, (3) skills acquisition, (4) skills consolidation and application training, (5) generalization and maintenance, and (6) post-treatment assessment follow-up.[45] CBT has been shown to have a role in the treatment plans for anxiety disorders[46] and depression.[47] CBT has been found to be an effective treatment for sleep disturbance and has been found to reduce inflammation in HD patients.[48] Recently, Chen et al[48] demonstrated that CBT is effective for correcting disorganized sleep patterns and that it reduced inflammation and oxidative stress in 72 sleep – disturbed HD patients. Therefore, CBT should be encouraged in HD patients.

This study had three main limitations. First, this was a cross-sectional analysis; this was not a prospective controlled study, so cause-and-effect relationships cannot be drawn from the findings. Second, the sample size was relatively small. Third, the diagnosis of sleep apnea syndrome depended on each patient's past history; therefore, the authors could not ensure the diagnosis of sleep apnea syndrome was correct for each patient.

Conclusion

In conclusion, poor SQ is a very common issue and is found to be associated with depression and poor HRQoL in elderly HD patients. Social and economic environment, family status, life events, personality, and biological consequences of aging may be additional determinants of depression, poor SQ, and poor HRQoL in this population. Assessment of SQ and bystander factors such as depression and HRQoL and

treatment of these factors should become a part of treatment for elderly dialysis patients.

Disclosure

The authors report no conflicts of interest in this work.

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