Original Article

Estimated Glomerular Filtration Rate and Sleep Quality in Stage 3-5 Non-Dialysis Chronic Kidney Disease Patients: Is There a Correlation?

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ABSTRACT

Background: Chronic kidney disease (CKD) is a growing health issue that significantly affects patients' quality of life. CKD patients are prone to sleep disturbances, which can lead to chronic fatigue and a decrease in their quality of life. The Pittsburgh Sleep Quality Index (PSQI) is a parameter that can be used to assess the sleep quality of CKD patients.
Objective: This study aims to determine the relationship between estimated glomerular filtration rate (eGFR) and sleep quality in non-dialysis CKD patients.
Methods: The research design is an observational analytic study with a cross-sectional approach. The research subjects were stage 3-5 non-dialysis CKD patients aged 18 to 60 years at Prof. Dr. R. D. Kandou Hospital Manado from March to May 2022. The sleep quality of CKD patients was assessed using the PSQI score. Data analysis was performed with a significance level of $p < 0.05$.
Results: A total of 30 patients with stage 3-5 non-dialysis CKD were found. They consisted of 20 males and 10 females, aged 38-59 years, with an average of 59.80 ± 9.86 years. In the normality test using Shapiro-Wilk, the patient samples were not normally distributed ($p = .000$). For statistical analysis using the Spearman test, a negative correlation was found between eGFR and PSQI scores ($r = -0.554$), which was statistically significant ($p = 0.002$).
Conclusion: This study found a significant relationship between eGFR and PSQI scores, which shows that a decrease in eGFR worsens the sleep quality of non-dialysis CKD patients.
Keywords: eGFR, PSQI, CKD.

Introduction

Kidney Disease Improving Global Outcomes (KDIGO) defines chronic kidney disease (CKD) as a persistent impairment in kidney structure or function that lasts longer than 3 months. This condition can present as functional or structural abnormalities, with or without a decline in glomerular filtration rate (GFR), and include pathological manifestations indicating kidney abnormalities. These include, regardless of kidney damage, abnormalities in the composition of blood or urine, abnormal imaging tests, and GFR below 60 ml/min/1.73m2 for 3 months.[1] With CKD prevalence increasing to 57% per year, it is becoming a growing health concern. In the United States, the incidence of chronic kidney failure has reached 10% or 1 in 10 people, with a high mortality rate of 615,000 patients experiencing chronic kidney failure, of which 92,000 patients died from chronic kidney failure in 2011.[2]

The incidence of chronic kidney failure in Indonesia is increasing. This disease is described as an iceberg phenomenon, where only about 0.1% of cases are detected, and 11-16% are undetected. Based on statistical data collected by the Indonesian Nephrology Association

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(Pernefri) in 2012, the number of patients with kidney failure increased by 10% from 2011 to 19,621 new patients, with 9,161 patients actively undergoing Hemodialysis therapy.[3]

Poor sleep quality often occurs in CKD patients, especially those who undergo hemodialysis. Daily sleepiness was the most frequently reported symptom, affecting 80% of CKD patients who experienced sleep disturbance at night.[4] This condition leads to negative impacts on hemodynamic changes, thus posing a significant risk for hypertension and complicating the process of hemodialysis. Previous studies have also shown that sleep apnea is linked to a higher risk of heart problems and increased mortality in patients with end-stage renal disease (ESRD).[4] Furthermore, chronic sleep deprivation can affect emotional condition, cognitive function, and memory function.[5-8]

One parameter used to assess an individual's sleep quality is the Pittsburgh Sleep Quality Index (PSQI). It includes 19 items grouped into 7 components, generates a single global score, and takes about 5 to 10 minutes to complete. Researchers at the University of Pittsburgh developed it. Components assessed in the PSQI include total sleep time, amount of time spent asleep, types of disturbances that may cause awakenings during sleep, whether medications influence sleep, and whether there is daytime drowsiness during daily activities.[9]

Poor health-related quality of life remains a challenge for patients with advanced CKD. The purpose of this study is to determine the relationship between glomerular filtration rate (GFR) in non-dialysis CKD patients and sleep quality.

Methods

Design and participants

The research design is an analytical observational study using a cross-sectional approach. The study subjects are non-dialysis CKD patients in stages 3 to 5, aged between 38 and 59, treated at Prof. Dr. R. D. Kandou Teaching Hospital between March and May 2022. The Pittsburgh Sleep Quality Index (PSQI), which consists of 19 items, was used to assess sleep quality. It is a self-administered questionnaire that evaluates patients' sleep quality for the previous 30 days.

Based on the patient's responses, the 19 questions are grouped into seven score components: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. Each component is scored from 0 to 3 to generate a global PSQI score ranging from 0 to 21. Higher PSQI scores indicate poor sleep quality, while a PSQI score <5 suggests good sleep quality.

Study covariates

Chronic Kidney Disease

Chronic Kidney Disease (CKD) is a significant health issue worldwide. According to the Kidney Disease Improving Global Outcomes (KDIGO), CKD is defined as an abnormality in kidney function or structure lasting for more than 3 months, characterized by structural or functional abnormalities, with or without a decrease in glomerular filtration rate (GFR) with pathological manifestations, indicating signs of kidney abnormalities, including abnormalities in blood or urine composition, or abnormalities in imaging tests; and GFR less than 60 ml/min/1.73m2 for 3 months, with or without kidney damage.[10] The CKD staging was based eGFR levels (CKD-EPI) using KDIGO classification: eGFR 45-59 ml/min/1.73m^2 was classified as stage 3a, eGFR 30-44 ml/min/1.73m^2 was classified as stage 3b, eGFR 15-29 ml/min/1.73m^2 was classified as stage 4, and eGFR less than 15 ml/min/1.73m^2 was classified as stage 5.[11]

Quality of Sleep

Sleep quality disturbances are a collection of symptoms experienced by patients, including symptoms related to sleep duration, sleep latency, medications needed for sleep, and daytime complaints expressed by the patient.[12]

Pittsburgh Sleep Quality Index (PSQI)

The parameter of sleep quality is a complex phenomenon that consists of quantitative components, such as sleep duration and sleep latency, and qualitative elements that vary between individuals. While sleep quality can be clinically assessed, the subjective components make it challenging to define and objectively measure. Buysse developed the Pittsburgh Sleep Quality Index (PSQI) in 1988, providing a standardized index that clinicians and patients can use to measure sleep quality. The PSQI questionnaire measures sleep quality over a 1-month interval through 19 questions that assess 7 components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, sleep medication use, and daytime dysfunction.[9]

Statistical analysis

Data analysis is conducted using SPSS version 27.0.0. A distributive statistic was used to calculate the means and standard deviation of the variables. The Shapiro-Wilk test was used to perform a normality test because the sample size was less than 50. If the data have a normal distribution ($p > 0.05$), the correlation analysis will be done using Pearson's test. Otherwise, Spearman's rank correlation test will be used. A 95% confidence interval was set, and a p-value less than 0.05 was considered significant.

Results

This study identified 30 non-dialysis CKD patients, comprising 20 males and 10 females, with an average age of 59.80 ± 9.86 years. The mean PSQI score was 9.50 ± 5.10 for males and 10.70 ± 4.97 for females. The mean eGFR for males and females was 18.30 ±12.85 and 20.60 ±35.09, respectively.

Table 1. Baseline characteristics of patients included in our study

Variables	Mean ± SD
Age	59.80 ± 9.86
Male	59.95 ± 10.12
Female	59.50 ± 9.86
PSQI	9.90 ± 5.01
Male	9.50 ± 5.10
Female	10.70 ± 4.97
eGFR	19.01 ± 22.17
Male	18.30 ±12.85
Female	20.60 ±35.09

Shapiro-Wilk test showed that the patient samples were not normally distributed (p=.000). As a result, Spearman's rank correlation test revealed a significant negative correlation between eGFR and PSQI score (r=-0.554, p=0.002).

Discussion

The direct effect of insomnia on CKD progression is associated with the dysregulation of blood pressure and the renal-angiotensin-aldosterone system (RAAS). During a normal sleep cycle, which is defined as 90 minutes of alternating between non-rapid eye movement (NREM) and rapid eye movement (REM), there is a slight fall in the blood pressure that triggers plasma renin activity (PRA). Later, this increase in PRA and aldosterone levels is observed in healthy subjects with sufficient night sleep and absent in sleep-deprived subjects. Thus, reduced sleep quality can lead to blood pressure dysregulation and contribute to CKD progression. Restless leg syndrome, characterized by involuntary limb movement, can cause sleep fragmentation and shorten the NREM/REM cycle.[13]

This study found that low eGFR levels are associated with poor sleep quality. This is

consistent with the findings of Tan et al. (2022), who reported that approximately half of CKD patients have poor sleep quality. CKD patients are prone to insomnia due to increased sleep latency, obstructive sleep apnea, restless leg syndrome, and a disturbed sleeping cycle.[14] Decreased production of serotonin and melatonin hormones in individuals over 60 can affect sleep processes and patterns, leading to sleep difficulties. A previous study conducted in Jakarta, Indonesia, in 2019 revealed that more than half of the hemodialysis subjects had experienced insomnia, and the main factors contributing to the sleep disturbance were depression and the duration of hemodialysis.[15] Anxiety in non-dialysis CKD patients is one of the problems affecting their sleep quality. Uremia conditions can disrupt melatonin hormone levels, affecting patient sleep quality.[16]

This finding is also consistent with the previous study by Shafi et al. (2017), which suggests that the sleep quality of dialysis and non-dialysis patients does not differ and indicates the presence of sleep quality disturbances in CKD patients.[17] It was found that there was a U-shaped association between sleep duration and the worsening of CKD. Sleeping less than 5 hours or more than 8 hours contributed to the progression of the renal disease.[7] However, another study conducted by Cao W et al. (2022) showed no direct relationship between decreased eGFR and sleep quality.[13] This contradictory result with the current study could also be possible because the researchers did not include patients over 60 years old, as these physiological processes experienced by geriatric patients are considered normal. Another study by Luca G. (2015) indicated that with increasing age, sleep quality improves.[18]

Conclusion

This study found a significant positive correlation between eGFR and PSQI score, indicating that a decrease in eGFR worsens sleep quality in non-dialysis CKD patients in stages 3-5.

Limitations of the Study

This study has several limitations. Further elaboration on the specific sleep disturbances experienced by patients is needed, which could provide a clearer understanding of the relationship. Therefore, the researchers suggest further research to explain better the association between eGFR and sleep disturbances in CKD patients. These varying research results indicate that sleep quality assessments should continue to be conducted to monitor patients' quality of life.

Declarations

Ethics approval and consent to participate

This article complied with all ethical rules at the research site.

Competing interests

The authors have no conflicts of interest to declare.

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Author's Contribution

Idea/concept: OU. Design: OU, SP. Control/supervision: ESM. Data collection/processing: OU, SP. Analysis/interpretation: OU. Literature review: ESM. Writing the article: OU, SP. Critical review: ESM. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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