



Factors Associated with Sleep Quality Score Among Stroke Patients A Cross-Sectional Secondary Analysis

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Abstract

Poor sleep after stroke may interfere with recovery and quality of life. This study examined factors associated with sleep quality among stroke patients. A cross-sectional secondary analysis used 165 records randomly selected from 197 complete responses in a source dataset of 200 respondents. Sleep quality was represented by an Pittsburgh Sleep Quality Index score derived from seven available components. We used descriptive statistics and Pearson or point-biserial correlations, with significance set at $p < 0.05$. The mean age was 41.2 ± 11.7 years, and 56.4% were male. Among 165 participants, the mean adapted total sleep-quality score was 9.80 ± 2.07 (95% CI 9.48–10.12), with a median of 10 and a range of 5–18. Sleep duration (2.59 ± 0.61) and habitual sleep efficiency (2.56 ± 0.96) had the highest mean component scores. Questionnaire-defined obesity was inversely associated with the total sleep-quality score ($r = -0.256$, 95% CI -0.393 to -0.107 ; $p = 0.001$). However, interpret this association cautiously because the questionnaire-defined obesity variable was inconsistent with calculated BMI categories. None of the other examined factors were significantly associated with the total score.

Keywords: Associated Factors; Pittsburgh Sleep Quality Index; Sleep Quality; Stroke

INTRODUCTION

Stroke continues to be a predominant cause of mortality and disability, resulting in persistent physical, psychological, and social repercussions for survivors (Feigin et al., 2021, 2025). Sleep disturbance is a significant yet often underrecognized issue following stroke. A systematic review and meta-analysis indicated that approximately 53% of stroke survivors suffer from poor sleep quality (Luo et al., 2023a), while insomnia and sleep-disordered breathing are also prevalent within this population (Baylan et al., 2020; Yang et al., 2024). Inadequate sleep may exacerbate fatigue, mood disturbances, participation in rehabilitation, and overall functional recovery (Choi-

Kwon & Kim, 2011; Fulk et al., 2020; Zhang et al., 2025).

The relationship between stroke and sleep is intricate. Cerebral lesions can modify sleep-wake regulation, circadian rhythms, and sleep architecture, whereas fragmented or insufficient sleep may exacerbate vascular risk and diminish neuroplasticity (Bassetti, 2019; Hermann & Bassetti, 2016; Khot & Morgenstern, 2019). Sleep quality following a stroke may also differ based on demographic characteristics, vascular comorbidities, body composition, smoking exposure, physical activity, psychological conditions, medication use, and daily sleep habits (Karaca, 2016). Identifying associated factors holds clinical

significance, as some may be amenable to modification via nursing assessments, educational interventions, symptom management, and appropriate referrals.

Previous Indonesian studies have consistently demonstrated that sleep disturbances are prevalent among stroke survivors. However, these studies have explored various and relatively narrow facets of post-stroke sleep. For instance, a study involving 57 patients who experienced ischemic stroke in Padang identified several sleep disorders and investigated their correlations with traditional stroke risk factors. Another investigation with 84 post-stroke outpatients examined the relationship between sleep quality and functional status. Additionally, other studies in Indonesia have focused specifically on diabetes mellitus, cognitive function, or descriptive profiles of sleep quality among stroke survivors (Ramadhini et al., 2020).

Research on sleep disturbances among stroke patients in Indonesia typically focuses on specific facets of post-stroke sleep or a limited number of related factors. Consequently, the more comprehensive relationships between sleep quality and demographic, anthropometric, clinical, behavioral, and sleep-related variables remain inadequately characterized. Using an existing dataset, this cross-sectional analysis aims to describe sleep quality and examine bivariable associations with the adapted total sleep-quality score. Given the study's design, it seeks to identify associations rather than establish causality or independent determinants.

Unlike previous Indonesian studies that predominantly examined individual correlates of post-stroke sleep, the present secondary analysis evaluates a broader set of demographic, clinical, cardiometabolic, and behavioral characteristics within a single stroke dataset. Consequently, This study aimed to describe sleep quality and examine demographic, anthropometric, clinical, behavioral, and sleep-related factors

associated with the adapted total sleep-quality score among stroke patients, including their associations after adjustment for relevant covariates. Considering the cross-sectional design, the study primarily assessed associations rather than causal relationships.

METHOD

This research employed a cross-sectional secondary analytical approach. The dataset utilized comprised 200 responses, of which 197 contained adequate information to compute all seven modified sleep-score components. For the current analysis, the minimum sample size was determined via an a priori power analysis conducted using G*Power 3.1. (Faul et al., 2009). Ho et al. (2021) reported correlations ranging from $r=0.216$ to $r=0.306$ among sleep quality, fatigue, community integration, and perceived social support in stroke survivors; a conservative expected effect size of $r=0.22$ was therefore utilized. For a two-tailed bivariate correlation, with an alpha level of 0.05 and a power of 80%, a minimum of 159 respondents was required. A total of 165 records were retained to account for a small margin above the minimum sample size, selected from the 197 complete records through simple random sampling. The source dataset comprised 200 records, of which 197 contained sufficient information to calculate all seven adapted sleep-quality components. An a priori sample-size calculation indicated that a minimum of 159 participants was required based on an expected correlation of $r = 0.22$, a two-sided α of 0.05, and 80% power. To provide a small allowance above the minimum requirement, an analytical sample of 165 records was predetermined. These 165 records were selected from the 197 complete eligible records using simple random sampling. The remaining 32 complete records were not excluded on clinical or data-quality grounds but were not selected for the present secondary analysis (Figure 1).

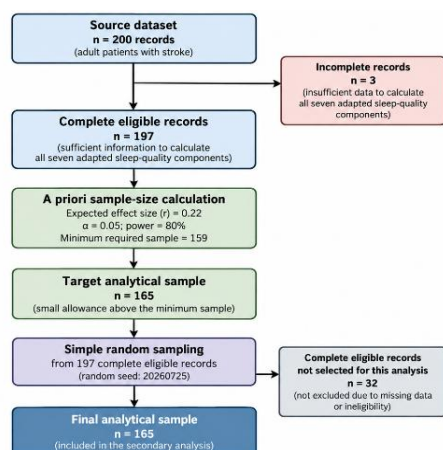


Figure 1. Flow diagram of record selection for the cross-sectional secondary analysis.

Notes:
 1. The source dataset consisted of 200 records; 197 records contained sufficient information to calculate all seven adapted sleep-quality components.
 2. An a priori sample-size calculation indicated a minimum required sample of 159 (expected $f = 0.22$, $\alpha = 0.05$, power = 80%).
 3. To provide a small allowance above the minimum sample, 165 records were selected using simple random sampling from the 197 complete eligible records (random seed: 20260725).
 4. The remaining 32 complete records were not selected for this secondary analysis, not excluded due to missing data or ineligibility.

Figure 1. Flow Diagram of Record Selection

The inclusion criteria encompassed adults identified in the source dataset as stroke patients with complete data on candidate factors and sleep components. The data collection was conducted in November 2025 from RS Lampung, with ethics approval number No III/099.1/KEPK-SLE/STIKEP/PPNI/JABAR/VIII/2025.

Sleep quality was represented by an adapted Pittsburgh Sleep Quality Index total score ranging from 0 to 21. Seven components were calculated: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, sleep-medication use, and daytime dysfunction. The disturbance component was based on eight available items because the source questionnaire combined feeling cold and feeling hot. The conventional cut-off of >5 was used only to provide a provisional descriptive classification and not as a validated diagnostic threshold for this score. Although the Indonesian PSQI has demonstrated acceptable psychometric properties among adolescents, its validity in adult stroke populations and for the adapted scoring procedure employed in this context has not been established (Buysse et al., 1989; Setyowati & Chung, 2021).

Candidate factors included age, sex, body mass index, hypertension, diabetes mellitus, physical inactivity, and previous stroke. Pearson correlation was employed for continuous predictors, while point-biserial correlation was used for dichotomous predictors. Statistical significance was established at $p < 0.05$. Due to only three participants exhibiting good sleep quality, multivariable logistic regression with a binary outcome was not conducted, as such a model would be unstable and susceptible to sparse-data bias.

RESULT AND DISCUSSION

The 165 respondents had a mean age of 41.2 ± 11.7 years and a median age of 38 years (range 20–77). Most were male (56.4%), younger than 40 years (53.3%), and in the normal body mass index category (95.8%). Hypertension (90.3%) and diabetes mellitus (85.5%) were frequent. More than half reported active or passive smoking exposure (56.4%), physical inactivity (51.5%), and daytime napping (63.6%). Selected characteristics are presented in Table 1.

Table 1. Characteristics of respondents (n=165)

Characteristic	Category/statistic	n	%
Age (years)	Mean $\pm$ SD	41.2 $\pm$ 11.7	–
Sex	Male	93	56.4
Age group	<40 years	88	53.3
Body mass index	Normal	158	95.8
Hypertension	Yes	149	90.3
Diabetes mellitus	Yes	141	85.5
Physical inactivity	Yes	85	51.5
Previous stroke	Yes	135	81.8

The mean adapted total sleep-quality score was 9.80 ± 2.07 , with a median of 10 and a range of 5–

18. Utilizing the adapted scoring procedure and the traditional PSQI cut-off, 162 respondents (98.2%) were temporarily categorized as experiencing poor sleep quality. The study documented a pooled prevalence of 53% utilizing validated sleep-quality scales (Luo et al., 2023b). Direct comparison is inappropriate because the current dataset employed modified component scoring and an unvalidated classification threshold. Consequently, the continuous adapted total score serves as the primary outcome, while the 98.2% classification should be viewed solely as a descriptive indicator that requires validation.

Table 2. Distribution of adapted sleep-quality scores (n=165)

Component	Mean±SD	Median	Min–max
Subjective sleep quality	0.85±0.50	1	0–3
Sleep latency	1.43±0.59	1	0–3
Sleep duration	2.59±0.61	3	1–3
Sleep efficiency	2.56±0.96	3	0–3
Sleep disturbances	1.28±0.49	1	0–3
Sleep-medication use	0.15±0.41	0	0–2
Daytime dysfunction	0.93±0.53	1	0–3
Adapted total score	9.80±2.07	10	5–18

Sleep duration and habitual sleep efficiency exhibited the highest component means, indicating that these domains contributed most significantly to the elevated adapted total score. Neurological alterations related to stroke and disrupted sleep–wake regulation may influence sleep duration and efficiency (Hermann & Bassetti, 2016; Khot & Morgenstern, 2019). Nevertheless, the dataset did not encompass standardized measures of functional capacity, fatigue, anxiety, depression, pain, or environmental factors,

thereby precluding the assessment of their correlations with the adapted sleep-quality score. The only factor identified through the questionnaire as significantly associated with the overall sleep quality was obesity ($r=-0.256$; $p=0.001$). Participants classified as obese exhibited a lower mean score compared to those classified as non-obese (8.76 versus 10.07), which paradoxically suggests better sleep quality rather than worse. This finding is counterintuitive, considering that obesity is a well-established risk factor for obstructive sleep apnea and sleep disturbances (Khot & Morgenstern, 2019). Importantly, the obesity as defined by the questionnaire differed from the category determined by the calculated body mass index: only seven respondents were classified as overweight, and none met the criteria for obesity based on the calculation. The significant association observed may therefore result from inconsistent definitions, coding errors, or residual confounding rather than indicating a protective effect. Consequently, it should not be interpreted as evidence that obesity enhances sleep..

Table 3. Factors associated with the adapted total sleep-quality score (n=165)

Factor	Mean score (0/1)	r	p	Interpretation
Questionnaire-defined obesity	10.07/8.76	-0.256	0.001	Significant *
Physical inactivity	9.49/10.09	0.147	0.059	Not significant
Sex (female/male)	9.54/10.00	0.110	0.158	Not significant
Body mass index	–	-0.106	0.174	Not significant
Daytime napping	9.55/9.94	0.092	0.241	Not significant
Age	–	0.009	0.910	Not significant

The association between physical inactivity and health outcomes demonstrated a weak positive correlation approaching statistical significance ($r=0.147$; $p=0.059$). Due to the lack of validated multidimensional instruments for measuring activity, stroke severity, and fatigue, the temporal or clinical implications of this finding remain undetermined. Variables such as sex, age, body mass index, vascular comorbidities, smoking exposure, obstructive sleep apnea, psychological stress, routine sleep medication use, previous stroke, and daytime napping did not exhibit statistically significant associations. It is important to note that a non-significant result does not necessarily indicate the absence of a clinically relevant relationship, especially in cases where exposure definitions are broad or imbalanced.

The study provides insights into the research question predominantly at the level of bivariable associations. It does not identify a singular dominant independent factor due to the absence of a multivariable model. Moreover, the substantial imbalance in the binary outcome—comprising three individuals classified as good sleepers and 162 as poor sleepers—renders the use of standard logistic regression inappropriate. Future analyses should consider maintaining the continuous nature of the total score and employing multivariable linear regression after verifying model assumptions, or alternatively, recruiting a more heterogeneous sample. Variables proposed within the conceptual framework, including functional independence, fatigue, anxiety, depression, pain, and the sleep environment, should be assessed with validated instruments.

In the context of nursing practice, the elevated sleep-quality scores substantiate the importance of incorporating routine sleep assessments during stroke follow-up and rehabilitation procedures. It is recommended that rehabilitation professionals

diligently screen stroke survivors for potential sleep disorders, as such disorders are correlated with less favorable functional outcomes (Fulk et al., 2020). Nurses should review sleep duration and efficiency, nighttime symptoms, medication use, suspected sleep-disordered breathing, and mood symptoms, while avoiding diagnostic conclusions from the adapted score alone. The primary limitations include the cross-sectional secondary design, unvalidated adapted scoring system, incomplete representation of multidomain factors, broad self-reported exposure categories, and the inability to establish temporality or independent effects.

CONCLUSION

Based on the Pittsburgh Sleep Quality Index (PSQI), 162 out of 165 respondents (98.2%) were provisionally classified as exhibiting poor sleep quality. Sleep duration and habitual sleep efficiency contributed the highest component scores. Questionnaire-defined obesity was the only statistically associated factor, but its negative direction and inconsistency with calculated body mass index categories indicate that the variable definition and coding must be verified before interpretation. Other demographic, anthropometric, clinical, behavioral, and sleep-habit factors were not statistically significant. The findings demonstrate bivariable association rather than causal influence and do not identify an independent dominant factor. Future studies should use a complete instrument validated for Indonesian adult stroke populations and apply adequately powered multivariable analysis.

DECLARATION

Author Contributions

JAR conceptualization and methodology, EB; original data collection, and interpretation, IS; funding acquisition, JAR, FR, WJ, IS, RNA, M; writing the

original draft, author initials; critical review and revision, author initials. All authors have read and approved the final manuscript and agree to be accountable for this work.

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Ethical Considerations

The source study received ethical approval under Approval No. III/099.1/KEPK-SLE/STIKEP/PPNI/JABAR/VIII/2025, as reported in the Methods section. The present study used a cross-sectional secondary analysis of existing records. Participant confidentiality and anonymity were protected, and the data were used solely for research and publication purposes.

Competing Interests

The authors declare no competing interests.

Acknowledgment

The authors thank to LPPM UMJ, the participants and the team involved in the original data collection.

Availability of Data and Materials

Data custodian's permission and applicable access restrictions: The data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to ethical approval, institutional permission, and participant confidentiality requirements.

Consent for Publication

Not applicable. This manuscript presents aggregate results and does not report identifiable individual participant information.

Clinical Trial Number

Not applicable. This was an observational cross-sectional secondary analysis and did not assign participants to an intervention.

Generative AI

During preparation of this manuscript, the authors used ChatGPT (OpenAI) to assist with drafting and English language editing of the declaration section and document formatting. AI-assisted technology was not used in this revision to collect data, perform statistical analyses, generate study results, or create references.

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