Association Between Sleep And Depression In Older Adults: A Cross-Sectional Study From The ELSI-Brazil Cohort

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Abstract

Background: The relationship between depression and sleep is bidirectional, but sleep disturbances may precede depressive episodes. Joo et al. (2022) found that men and women from a Korean population with poor sleep quality are seven times more likely to be depressed. This study aims to replicate the previous model in the ELSI-Brazil population considering potential cross-cultural differences.

Methods: A cross-sectional analysis of Wave 2 of ELSI-Brazil (2019–2021) was performed including 6365 participants aged 50 or older. Demographic, socioeconomic, and health-related characteristics were described. Multivariable logistic regression was used to analyze the association between depression and poor sleep quality.

Results: The prevalence of poor sleep quality in this elderly population was 15.6%. Patients with poor sleep quality were four times more likely to be depressed. A significant interaction was found between sex and sleep quality in the association with depression (p=0.04). The adjusted model stratified by sex found that men and women with poor sleep quality were three (OR = 3.11 [95% CI 2.39–4.05]) and four (OR = 4.39 [95% CI 3.60–5.35]) times more likely to be depressed respectively.

Conclusion: We found a significant sleep-depression association among Brazilian elders, particularly impacting women. Gender-specific interventions for sleep-related mental health are crucial. Despite limitations, the study provides valuable insights emphasizing the need for tailored public health measures, especially in nursing homes, to prevent depression and improve the quality of life in this vulnerable group.

Introduction

Depression affects nearly 18.5% of adults in the USA, particularly impacting women, young adults, and individuals with lower education levels. Depression is also associated with chronic diseases such as diabetes, arthritis, and cardiovascular disease (Lee et al., 2023). In addition, global epidemiological studies have identified an association between depression and poor sleep quality, whose causal relationship remains unclear. (Amelia et al., 2022; Hu et al., 2020; Joo et al., 2022). The identified association appears bidirectional, as most depressed people suffer from poor sleep quality, and patients with insomnia are depressed (Anderson & Bradley, 2013). Further evidence suggests that sleep issues early in life precede depression episodes that persist throughout adulthood (Touchette et al., 2012).

There have been efforts to elucidate the magnitude of the sleep-depression relationship. Joo et al. (2022) found that men and women with poor sleep quality from the Korean Community Health Survey in 2018 were seven times more likely to suffer from depression. In addition, Hu et al. (2020) found that older adults from Chinese nursing homes were three times more likely to be depressed. Understanding the consequences of poor sleep quality in the elderly may help promote public health interventions to improve their quality of life.

It is still being determined if the findings from Joo et al. (2022) apply to different cultures and age groups. As such, we aim to replicate the association model between depression and sleep quality, as reported by Joo et al. 2022 in the Brazilian elderly population from the Brazilian Longitudinal Study of Aging (ELSI-Brazil). This study will allow for the identification and deeper understanding of potential

cross-culture differences in sleep quality, increasing the external validity of the results.

Materials and Methods

Study Design

Our study design is a cross-sectional analysis of Wave 2 of The Brazilian Longitudinal Study of Ageing (ELSI-Brazil), sampled between 2019 and 2021 (Lima-Costa et al., 2023). The ELSI-Brazil provides a representative sample of Brazil's aged population (≥50 years old). Through a national survey, the authors collected several individual measures, including demographics, lifestyle, general health, previous diseases, ability to perform activities of daily living, cognitive function, depressive symptoms, psychosocial measures, and use of medications. Data was collected from 6,974 participants; however, 609 were excluded due to missing values (Figure 1). Therefore, the current analysis utilized only the data from participants with complete information. All participants signed a written informed consent for the survey, which is now publicly accessible. Therefore, no ethical approval was required.

Exposure

The exposure was assessed by participants subjectively reporting the quality of their sleep. The sleep quality was dichotomized into good ("very good," "good," and "fair") and bad ("bad" and "very bad"). For comparison, we have analyzed the model categorizing the response "fair" as poor sleep quality. In addition, participants were asked if they had been previously diagnosed by a medical professional, taken any sleep medications during the last month and if their doctors had said they had sleep problems.

Outcomes

The outcome variable was the presence of depressive symptoms as categorized for participants with a score of nine or more in the 8-item Center for Epidemiological Studies Depression Scale (CES-D-8). The CES-D-8 is a validated questionnaire for assessing depressive symptoms in older people in clinical and research settings (Turvey et al., 1999). Each positive answer from the eight questions is scored as 3 points. A cut-off of 9 points has been proposed to identify those with clinically relevant depressive symptoms (Briggs et al., 2018). In addition, the previous diagnosis of depression and the current use of antidepressants were also inquired about and collected into categories.

Covariates

To replicate the model Joo et al. (2022) used, most demographic, socioeconomic, and health-related characteristics were included as covariates in the adjusted model (Table 1). The demographic and socioeconomic variables included categories of age, marital status, education level, geographical area, income score, and retirement status. These last two differ slightly from the original model. The income score was collected by asking the participants how they would describe their household income. Furthermore, instead of the type of job, as per the original model, we included retirement status because the former variable was not gathered from the ELSI-Brazil participants. The health-related variables were smoking status, drinking frequency, weekly walking sessions, and body mass index (BMI), categorized into strata. We used subjective discrimination as a surrogate for stress, measured in the original model. Perceived discrimination has been associated negatively with mental well-being in older adults and proposed as a risk factor for depression, regarded as a social stressor (Sutin et al., 2015; Hosler et al., 2019).

Statistical Analysis

We described the baseline characteristics of the population using absolute and relative frequencies of each categorical variable, as well as mean and standard deviations of continuous variables. Multivariable logistic regression was used to analyze the differences between depressed and non-depressed patients according to the presence of poor sleep quality, adjusting for the relevant covariates. The results were reported in odds ratio (OR) and 95 confidence intervals (95% CIs). A p-value of <0.05 was defined as the statistical significance level. The effect modification of sex was analyzed in the adjusted model. Due to a statistically significant modification and gender differences in depression (Weissman & Klerman, 1977), we stratified the final regression model by gender. A subgroup analysis stratified the population by each covariate was performed to find the most significant effect sizes in every subgroup. Sensitivity analyses were conducted to analyze the association when modifying the categorization of the primary exposure (sleep quality) and changing the variable used as the primary exposure. All statistical analyses were conducted using STATA 18 software (College Station, TX).

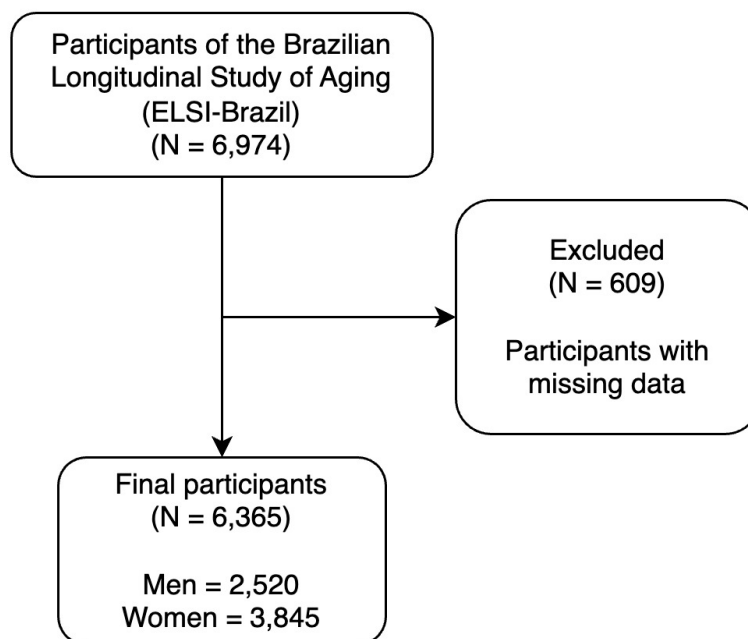## Results

Baseline Characteristics

Figure 1: *Flow diagram of studies assessed for eligibility according to PRISMA criteria.*

The characteristics of the included participants are represented in Table 2. The total number of participants was 6,365, of which 3,845 (60.4%) were women and 2,520 (39.6%) were men. The prevalence of poor sleep quality in this elderly population was 15.6%; more specifically, 11.1% of the men and 18.6% of the women reported subjective poor sleep quality. Among the poor sleep quality group, 67% of the men and 80% of the women were categorized as depressed with a CED-8-item scale of 9 points or more. Men and women with poor sleep quality were statistically more likely to experience depressive symptoms (p=0.000).

Main Results

DThe multivariate logistic regression model showed that patients with poor sleep quality were four times more likely to be depressed (OR=4.1 [3.35 - 5.01]) (Table 3). There is a statistically significant interaction between sex and sleep quality in the association with depression (p=0.04). Therefore, the association between sleep quality and depression depended on the sex of the patient. Specifically, women with poor sleep quality are more likely to be depressed than men with poor sleep quality. The adjusted model stratified by sex (Table 3) demonstrated that men and women with poor sleep quality were more likely to be depressed. Compared

with those of the reference group, the ORs (95% CIs) for depression in the group with poor sleep quality were OR = 3.11 [95% CI, 2.39–4.05] in men and OR = 4.39 [95% CI, 3.60–5.35] in women.

Sensitivity Analysis

We obtained similar results when sleep quality recategorization (Table A.1) was used for the analysis. The association was generally more efficient by categorizing "fair" as poor sleep quality, as seen from the shorter confidence intervals. Furthermore, the association remained significant when we used a different exposure, such as previous diagnosis of depression, categorical subjective sleep quality, and weekly use of sleep medications (Table A.2). There was an exposure-response relationship between sleep quality, the use of sleep medications, and depression. The exception was for men using less than one sleep medication per week. They were not more likely to have depression compared with men who do not use sleep medications (OR 1.59 95% CI[0.84-2.99]).

Subgroup Analysis

The relationship between sleep quality and depression stratified by sex was analyzed by subgroup of each covariate in Table 5. In both men and women, patients in their fifties (OR 4.28 for men; OR 4.91

for women), divorced (OR 4.30 for men; OR 7.74 for women), drinking more than once per month (OR 3.43 for men; OR 14.46 for women) and non-discriminated (OR 3.89 for men; OR 6.32 for women) had higher ORs than their counterpart subgroups. Nevertheless, there were differences between men and women in the rest of the subgroups when stratifying by educational level, area of residence, income, retirement status, smoking status, walking frequency, and BMI.

Discussion

We found a strong link between sleep quality, depression, and gender as an interaction factor. Both men and women with poor sleep quality were three and four times, respectively, more likely to have depression. Furthermore, when adjusted, both men and women show a tendency toward depression when poor sleep quality is present. However, there is still a need for gender-specific approaches to address sleep-related mental health concerns. Similar findings were reported by Joo et al. in their subgroup analysis.

Compared to the study by Joo et al. (2022), we found a weaker association between poor sleep quality and depression. The difference could be related to the power of our study since their sample size was more prominent than ours (176,194 patients vs 6,365 patients). There were also differences in the prevalence of poor sleep quality and depressive symptoms in the exposed groups. Joo et al. (2022) reported a prevalence of poor sleep quality of 72% in men and 46% in women. Among them, the prevalence of depression was less than 10% in both groups. In contrast, we found a more negligible prevalence of poor-quality sleep. However, 67% of men and 80% of women from this exposed group were depressed. These differences may be due to different measurement instruments used to gather the survey's clinical data.

Similar studies found the same relationship in a cross-sectional study of the elderly in Sao Carlos, São Paulo, which found that 51.8% of the women have sleep problems, with statistically significant results found between sleep quality and sex (p=0.008). In our study, this relation was also significant (p=0.04) (Mota S et al., 2021). Another cross-sectional study was made in Indonesia, where they evaluated the relation between the lack of sleep quality and depression; they identified poor sleep quality as a factor leading to a higher risk of depression (OR = 4.2; 95% CI: 3.7–4.6; p < 0.001), comparing with our study we obtained similar results in the Brazilian elderly population (OR = 4.1; 95% CI: 3.5–5.01; p < 0.0001) (Amelia et al., 2022)

The biological basis of this sleep-mood relationship may involve inflammatory cytokines that can be activated by sleep disruption and a decrease in monoamines such as serotonin and norepinephrine (Fang et al., 2019). As evidenced here, there is also epidemiological evidence that people with sleep disturbances have higher odds of depression. Furthermore, poor sleep quality may have consequences on cognition in elderly patients, acting as a mediator factor along with depression (Liu, 2022; China). Lastly, sleep quality and duration were independently associated with worsened quality of life in older adults (Hu et al., 2022).

Therefore, it is essential to implement public health measures aimed at reducing the prevalence of depression among the elderly. These interventions should target particularly older adults living in nursing homes, as the prevalence of sleep disturbances is significantly larger (Hu et al., 2019; Orhan et al., 2011). Hu et al. (2022) found that physical activity can modulate the effect of poor sleep quality on depression and quality of life. Also, common pathophysiological pathways in disturbances of neurotransmitters may suggest that antidepressants or interventions aimed at modulating serotonin and norepinephrine alterations may effectively treat comorbid sleep and mood disorders (Fang et al., 2019). Future clinical research should focus on elucidating the causal association between sleep and depression in prospective studies and assessing the efficacy of clinical interventions in randomized clinical trials. Exercise programs with moderate-intensity exercises, considered 150 minutes per week, are reported to have a positive outcome and improve sleep quality in older adults over 60. Low-intensity and combined low-to-moderate-intensity exercises are preferable to vigorous-intensity exercise. One of the most recommended types of exercise is Tai Chi, and social participation has shown additional benefits (Vanderlinden et al.).

There were some limitations in this replication study. First, there were differences between the study used for the replication model (Joo et al., 2020). Our sample size was smaller, and the covariates used for the model differed. To adapt these changes to our population, we attempted to replace similar covariates, stress with discrimination, and job type with retirement status. Another limitation is that we used a self-report scale to measure sleep quality instead of a validated instrument. The lack of a validated questionnaire also prevented us from analyzing specific components of sleep patterns. This difference in tools could introduce a measurement bias in our project, affecting the validity of the results. Lastly, we only analyzed the ELSI-Brazil participants with

a complete dataset. There are likely relevant differences related to the outcome between included and excluded participants, such as socioeconomic and cognitive factors, to be able to answer the complete set of questions from the survey. Another limitation of this study is its cross-sectional design, which precludes establishing causality. Future projects should be undertaken to investigate causal relationships.

Conclusion

Our study on Brazilian elders highlights a significant link between sleep quality, depression, and gender. Men and women with poor sleep quality are three and four times more likely to have depression compared to those with good sleep quality. Notably, we found a significant interaction with gender, making women more prone to depression due to poor sleep than men. While our findings contribute to understanding the nature of the sleep-depression relationship, future prospective studies should focus on elucidating its causal pathway considering gender interaction. Public health measures should prioritize tailored interventions for sleep issues, especially in nursing homes.

Funding

Conflicts of Interest

The authors declare no conflict of interest.

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