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Night Shift Work and Poor Sleep Quality Among Female Workers in Southern Brazil: A Repeated Cross-Sectional Study (2017–2022)

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Purpose: Night shift work has been identified as a significant risk factor for various health issues, particularly among women, whose vulnerability to poor sleep quality may be exacerbated by sociocultural and occupational dynamics. In this study, we examined the association between night shift work and poor sleep quality among female workers.

Patients and Methods: This repeated cross-sectional study is part of a broader investigation entitled "Health Conditions of Female Shift Workers: A Longitudinal Occupational Health Study" (ELO SAÚDE). The study was conducted among adult female factory workers employed by the same industrial group in southern Brazil, with data collected in 2017 (n = 394) and 2022 (n = 399). Poor sleep quality was defined as a Pittsburgh Sleep Quality Index (PSQI) score > 5. Night shift work was characterized by work schedules starting and ending between 10:00 PM and 6:00 AM. Prevalence ratios (PR) and 95% confidence intervals (CI) were estimated using Poisson regression with robust variance.

Results: The mean age of participants was 35.8 ± 9.1 years in 2017 and 34.2 ± 9.9 years in 2022. The prevalence of poor sleep quality increased significantly from 58.3% (95% CI: 53.4–63.2%) in 2017 to 67.7% (95% CI: 63.0–72.3%) in 2022 (p = 0.007). After adjusting for potential confounders, night shift work was associated with a 30% higher prevalence of poor sleep quality in 2017 (PR = 1.30; 95% CI: 1.10–1.55; p = 0.002) and 25% higher in 2022 (PR = 1.25; 95% CI: 1.10–1.43; p < 0.001).

Conclusion: Poor sleep quality remains highly prevalent and significantly associated with night shift work among female workers, with a notable increase over time. Thus, interventions focused on enhancing sleep hygiene and optimizing shift schedules are warranted in this population.

Keywords: sleep quality, shift work, night work, cross-sectional studies, repeated survey, women

Introduction

Sleep is a vital biological function influenced by genetic and environmental factors.[1] It is essential for sustaining life and is regulated by the sleep-wake cycle, which directly impacts its duration and quality.[2,3] This cycle closely interacts with the circadian rhythm, an innate regulatory system coordinated by the central nervous system and synchronized with environmental cues.[4] Although the circadian rhythm is an endogenous and relatively stable process, it can become desynchronized, resulting in slower physiological and behavioral adaptation.[2,4,5] Its alignment depends on the interaction between the sleep-wake cycle and hormonal regulation, particularly the release of melatonin at night and cortisol in the morning.[4,6] Factors such as irregular sleep patterns, exposure to artificial light, work schedules, diet, and physical activity can disrupt this rhythm.[4,7,8]

Sleep quality refers to an individual's overall satisfaction with sleep, encompassing aspects such as sleep efficiency, sleep latency, sleep duration, and waking after sleep onset.[9] Poor sleep quality is highly prevalent worldwide, although estimates vary according to the population studied and the diagnostic criteria applied.[10–12] It is considered a major public health concern and is associated with numerous adverse health outcomes.[13–20] Moreover, sleep quality often differs

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between men and women due to physiological factors, such as hormonal fluctuations,[21] as well as social factors, including domestic and caregiving responsibilities.[22]

Night-shift work, defined as work performed between midnight and 5:00 a.m.,[23] is recognized as a significant risk factor for various adverse health outcomes.[17] Health risks associated with shift work are likely mediated by disruptions to the circadian rhythm and subsequent sleep disorders.[24] In women, circadian misalignment has been linked to adverse outcomes including elevated risks of breast cancer,[25] diabetes mellitus,[26] and impairments in reproductive function.[27] Additionally, previous findings from our research group have shown that female night-shift workers are more likely to experience body image dissatisfaction[28] and exhibit a high prevalence of hypovitaminosis D,[29] among other health-related outcomes.

According to a global meta-analysis, approximately 32% of women employed in industrial occupations report sleep-related impairments.[30] Higher prevalence rates have been documented among women working night shifts.[11,20,31] Although several studies have examined the association between night-shift work and poor sleep quality,[11,32,33] this relationship remains insufficiently explored among Brazilian female workers. This issue constitutes a significant public health concern, given that women workers represent an increasingly prominent segment of the labor force and may experience distinct conditions compared to other populations, particularly within the sociocultural and occupational contexts of Latin America.

Therefore, we aimed to examine the association between night shift work and poor sleep quality among female workers, using a repeated cross-sectional design with two independent samples of women from southern Brazil (2017 and 2022). This study provides novel insights into temporal trends and potential occupational determinants of poor sleep quality among female shift workers, particularly considering that this period allows for comparisons before and after the COVID-19 pandemic, which has been widely reported to affect sleep and mental health. We hypothesized that women working night shifts would consistently exhibit a higher prevalence of poor sleep quality compared with day workers. These findings are expected to inform prevention and intervention strategies tailored to this specific workforce.

Material and Methods

Study Design and Population

This study employed a repeated cross-sectional design, comparing two occupation-based surveys conducted among adult female factory workers from the same industrial group in southern Brazil. Data were collected at two distinct time points: the first in 2017 and the second in 2022. To ensure the reliability of temporal comparisons, both surveys applied harmonized methodologies.

The research forms part of the larger investigation titled "Health Conditions of Female Shift Workers: A Longitudinal Occupational Health Study" (ELO SAÚDE). Ethical approval was granted by the Research Ethics Committee at the University of Vale do Rio dos Sinos (approval numbers 2.057.810 for 2017 and 5.275.921 for 2022). Informed consent was obtained from all participants in line with the principles outlined in the Declaration of Helsinki regarding research involving human subjects.

Samples and Sampling

Eligibility for both surveys included all women aged 18 years or older employed at factories from the same corporate group dedicated to producing household plastic goods. In the 2017 round, only production workers were enrolled, whereas in 2022, administrative personnel (n = 93) were also included alongside production workers. Participants were excluded if they were pregnant, temporarily on leave, or had worked in their current shift for less than three months.

In 2017, 450 out of 553 eligible workers were interviewed after accounting for losses and refusals.[34–36] In 2022, 452 out of 546 eligible workers were interviewed, among whom 102 had also participated in the 2017 assessment. To ensure independence between the two samples, these 102 repeated respondents were not included simultaneously in both datasets. Instead, they were randomly allocated to one of the two samples, with 51 assigned to the 2017 dataset and 51 to the 2022 dataset. Following this procedure, each sample consisted of 400 unique participants.

A sensitivity analysis was performed, which demonstrated that the distribution of sample characteristics remained consistent across the 2017 and 2022 samples after the random allocation of repeated respondents.

Data Collection and Instruments

The first data collection took place between June and August 2017, while the second occurred from August 2022 to February 2023. On both occasions, participants were interviewed in person at their workplace using a standardized, precoded, and pretested questionnaire developed by the authors. The instrument gathered information on demographic, socioeconomic, behavioral, occupational, and health-related factors. Interviewers received specific training, and a pilot phase involving 21 interviews was conducted prior to the main survey to refine procedures.

Quality assurance measures included field supervision and post-interview telephone verification of 10% of the respondents, during which selected items were re-asked to assess data consistency. Questionnaire coding was performed jointly by the interviewers and the study coordinators.

Poor Sleep Quality: Outcome

The primary outcome of interest was poor sleep quality, evaluated using the Pittsburgh Sleep Quality Index (PSQI).[37] The Brazilian Portuguese version of the PSQI, previously validated for accuracy and reliability,[38] was employed in both surveys. This self-reported instrument examines sleep patterns and disturbances over the preceding month through 19 items, grouped into seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. Each component yields a score from 0 to 3, contributing to a global score ranging from 0 to 21. A total score above 5 (PSQI > 5) was used to indicate poor sleep quality.[37,38] In the 2017 dataset, individual scores ranged from 0 to 16, while in 2022, the range extended from 1 to 18.

Main Exposure: Night Shift Work

All interviews were conducted during participants' regular working hours. The production workforce was distributed across three fixed shifts: morning (06:00 AM–02:00 PM), afternoon (02:00 PM–10:00 PM), and night (10:00 PM–06:00 AM). Administrative staff followed daytime schedules ranging between 07:00 AM and 07:00 PM. Shift schedules were recorded for each participant and subsequently categorized into two broader groups for analysis: "day shift" (06:00 AM–10:00 PM) and "night shift" (10:00 PM–06:00 AM).

Explanatory Variables (Covariates)

Information on demographic, socioeconomic, behavioral, occupational, and health-related characteristics was collected to characterize the study population and to account for potential confounding variables in the multivariable analyses.

Demographic and socioeconomic variables included age (categorized as 18–30, 31–40, and >40 years); self-identified race/skin color (White/Caucasian or Other, comprising Black, mixed-race, Indigenous, or Asian); marital status (with or without a partner); educational attainment, expressed as total years of completed schooling (≤8, 9–11, and ≥12 years); and per capita household income. Household income was derived by dividing the total earnings of all household members in the previous month by the number of residents and subsequently categorized according to Brazilian minimum wage thresholds (<1, 1–2, and >2 minimum wages), based on the national minimum wage applicable at the time of data collection (2017: BRL 937.00; 2022: BRL 1,212.00).

Behavioral variables comprised leisure-time physical activity, number of daily meals, smoking status, and alcohol consumption. Leisure-time physical activity was determined based on whether participants reported engaging in any sport, exercise, or other physical activity outside of commuting during the preceding week and classified as physically active ("yes") or inactive ("no"). The number of daily meals (including breakfast, morning snack, lunch, afternoon snack, dinner, evening snack, and midnight snack) was recorded and subsequently categorized based on the median value (≤3 vs ≥4 meals per day). Smoking status was classified as non-smoker, former smoker, or current smoker. Alcohol consumption was categorized as "yes" for regular intake (at least once per week over the past year) and "no" for no intake or intake less than once per week.

Occupational and health-related variables included length of employment in the factory and self-rated health status. Duration of employment was categorized as ≤3 years, 4–6 years, or >6 years. Self-rated health was assessed using a five-point Likert scale and subsequently grouped into three categories: excellent/very good, good, and fair/poor.

Statistical Analysis

Data entry was performed using EpiData software version 3.1 (Centers for Disease Control and Prevention, Atlanta, United States), following a double-entry procedure, data entry comparison, and consistency analysis. Additionally, the 2017 and 2022 datasets were consolidated (using the merge command), with variables standardized to have identical category values.

Descriptive statistics were used separately for the 2017 and 2022 samples to describe the distribution of sample characteristics, the outcome variable (poor sleep quality), and the main exposure variable (night shift work) through absolute and relative frequencies. Numerical variables were summarized using means and standard deviations. Pearson's chi-square test for heterogeneity of proportions was applied to: (1) compare the distribution of poor sleep quality and night shift work according to sample characteristics (covariates) separately for the 2017 and 2022 samples; (2) assess the heterogeneity of proportions for poor sleep quality, night shift work and covariates between 2017 and 2022; and (3) evaluate the heterogeneity of proportions related to poor sleep quality or night shift work across covariates categories between 2017 and 2022.

To investigate the association between night shift work and poor sleep quality, separately for the 2017 and 2022 samples, prevalence ratios (PR) and their 95% confidence intervals (95% CI) were calculated using Poisson regression with robust variance.[39] It provides an alternative to logistic regression in cross-sectional studies with binary outcomes, given that the odds ratio can markedly overestimate the prevalence ratio (PR) when analyzing outcomes with high prevalence.[39] The multivariate models included: Model I (unadjusted), Model II (adjusted for demographic and socioeconomic characteristics), Model III (adjusted for Model II + behavioral and occupational characteristics), and Model IV (adjusted for Model III + health characteristics). All covariates associated with night shift work and poor sleep quality ($p < 0.10$ in unadjusted analysis) were considered potential confounders and were included in the multivariate analysis based on a conceptual model defined a priori.[40]

All analyses were conducted using Stata software version 12.0 (StataCorp LP, College Station, TX, USA), with associations considered statistically significant at a p-value of less than 0.05 ($p < 0.05$).

Results

Of the 400 female workers in each sample, this analysis included 394 participants in 2017 (mean age: 35.8 ± 9.1 years) and 399 in 2022 (mean age: 34.2 ± 9.9 years). Six workers in 2017 and one in 2022 were excluded due to incomplete sleep quality data. Table 1 presents the general characteristics of the samples. Most workers had white/Caucasian skin color, 9–12 years of education, a 1–2 minimum wage per capita family income, were physically inactive, non-smokers, non-drinkers, had ≤3 years of employment, and reported good perceived health. Marital status, education, per capita family income, and employment length showed significant heterogeneity between 2017 and 2022 (Table 1).

The prevalence of poor sleep quality increased from 58.3% (95% CI: 53.4–63.2%) in 2017 to 67.7% (95% CI: 63.0–72.3%) in 2022 ($p = 0.007$). Table 1 presents its prevalence alongside night shift work across covariates. Poor sleep quality was consistently higher among workers with fewer daily meals and poorer self-perceived health in both years. In 2017, it was more prevalent among those aged 31–40 years and with lower per capita family income, whereas in 2022, it was higher among physically inactive workers and smokers. Night shift work was more common among those with fewer daily meals. In 2017, it was more prevalent among physically active workers aged 31–40 years, while in 2022, it was more frequent among those with fewer years of education and poorer self-perceived health (Table 1).

When comparing poor sleep quality and night shift work across covariate categories between 2017 and 2022, poor sleep quality was consistently higher in 2022, particularly among the youngest and oldest age groups, white/Caucasian workers, those with a partner, 9–11 years of education, 1–2 minimum wages per capita income, physical inactivity, ≥4 meals/day, non-smokers, smokers, non-drinkers, ≤3 years of employment, as well as those with poor self-perceived health. Night shift work proportions differed significantly among workers aged 31–40 years, those with >2 minimum wages per capita income, physically active workers, and those reporting excellent self-perceived health (Table 1).

Table 2 presents the prevalence ratios for the association between night shift work and poor sleep quality in 2017 and 2022. A significant association was observed in both years. In the unadjusted analysis, night shift work was linked to

Table 1 Sample Distribution and Prevalence of Poor Sleep Quality and Night Shift Work According to Demographic, Socioeconomic, Occupational, Behavioral, and Health Characteristics of Female Workers in Southern Brazil, 2017 (N=394) and 2022 (N=399)

Characteristics	2017 (N=394)			2022 (N=399)		
	n (%)	Poor Sleep Quality (PSQI Score >5) *p-value*[a] n (%)	Night Shift Work *p-value*[a] n (%)	n (%)	Poor Sleep Quality (PSQI score >5) *p-value*[a] n (%)	Night Shift Work *p-value*[a] n (%)
Age (years)		p=0.029	p=0.011		p=0.074	p=0.112
18–30	131 (33.3)	78 (59.5)	19 (14.5)	160 (40.1)	117 (73.1)[c]	27 (16.9)
31–40	134 (34.0)	88 (65.7)	40 (29.9)	132 (33.1)	80 (60.6)	25 (18.9)[c]
> 40	129 (32.7)	64 (49.6)	30 (23.3)	107 (26.8)	73 (68.2)[c]	29 (27.1)
Skin color/race	n=393	p=0.812	p=0.442		p=0.787	p=0.169
White/Caucasian	265 (67.4)	154 (58.1)	63 (23.8)	281 (70.4)	189 (67.3)[c]	52 (18.5)
Others	128 (32.6)	76 (59.4)	26 (20.3)	118 (30.0)	81 (68.6)	29 (24.6)
Marital status[b]		p=0.097	p=0.770		p=0.702	p=0.589
Without a partner	178 (45.2)	112 (62.9)	39 (21.9)	211 (52.9)	141 (66.8)	45 (21.3)
With a partner	216 (54.8)	118 (54.6)	50 (23.2)	188 (47.1)	129 (68.6)[c]	36 (19.2)
Education level (years)[b]		p=0.517	p=0.331		p=0.310	p<0.001
≤ 8	59 (15.0)	37 (62.7)	11 (18.6)	26 (6.5)	21 (80.8)	8 (30.8)
9–11	301 (76.4)	171 (56.8)	73 (24.3)	207 (51.9)	140 (67.6)[c]	56 (27.1)
≥ 12	34 (8.6)	22 (64.7)	5 (14.7)	166 (41.6)	109 (65.7)	17 (10.2)
Per capita household income (MW)[b]		p=0.014	p=0.289		p=0.062	p=0.165
< 1	143 (36.3)	96 (67.8)	27 (18.9)	155 (38.9)	104 (67.1)	36 (23.2)
1–2	207 (52.5)	108 (52.2)	49 (23.7)	160 (40.1)	117 (73.1)[c]	34 (21.3)
> 2	44 (11.2)	25 (56.8)	13 (29.6)	84 (21.1)	49 (58.3)	11 (13.1)[c]
Leisure-time physical activity		p=0.897	p=0.065		p=0.017	p=0.116
Yes	95 (24.1)	56 (59.0)	28 (29.5)	117 (29.3)	69 (59.0)	18 (15.4)[c]
No	299 (75.9)	174 (58.2)	61 (20.4)	282 (70.7)	201 (71.3)[c]	63 (22.3)
Number of daily meals		p<0.001	p<0.001		p=0.026	p<0.001
≥ 4	247 (62.7)	126 (51.0)	29 (11.7)	228 (57.1)	144 (63.2)[c]	19 (8.3)
≤ 3	147 (37.3)	104 (70.8)	60 (40.8)	171 (42.9)	126 (73.7)	62 (36.3)
Current smoking status		p=0.539	p=0.352		p=0.049	p=0.924
Non-smoker	293 (74.3)	167 (57.0)	61 (20.8)	307 (76.9)	202 (65.8)[c]	61 (19.9)
Former smoker	70 (17.8)	45 (64.3)	19 (27.1)	65 (16.3)	44 (67.7)	14 (21.5)
Smoker	31 (7.9)	18 (58.1)	9 (29.0)	27 (6.8)	24 (88.9)[c]	6 (22.2)
Alcohol consumption		p=0.071	p=0.454		p=0.675	p=0.084
No consumption	266 (67.5)	147 (55.3)	63 (23.7)	279 (69.9)	187 (67.0)[c]	63 (22.6)
Consumption of at least once per week	128 (32.5)	83 (64.8)	26 (20.3)	120 (30.1)	83 (69.2)	18 (15.0)
Length of employment (years)[b]		p=0.075	p=0.244		p=0.447	p=0.540
≤ 3	151 (38.3)	80 (53.0)	28 (18.5)	228 (57.1)	160 (70.2)[c]	42 (18.4)
4–6	109 (27.7)	73 (67.0)	25 (24.9)	51 (12.8)	32 (62.8)	11 (21.6)
> 6	134 (34.0)	77 (57.5)	36 (26.9)	120 (30.1)	78 (65.0)	28 (23.3)
Self-perceived health status		p<0.001	p=0.242		p<0.001	p=0.031
Excellent/Very Good	92 (23.4)	37 (40.2)	23 (25.0)	110 (27.6)	58 (52.7)	14 (12.7)[c]
Good	181 (45.9)	109 (60.2)	34 (18.8)	186 (46.6)	124 (66.7)	39 (21.0)
Fair/Poor	121 (30.7)	84 (69.4)	32 (26.5)	103 (25.8)	88 (85.4)[c]	28 (27.2)

Notes: [a]*P-value* for Pearson's Chi-Square test for heterogeneity of proportions. [b] Characteristics with a $p<0.05$ from Pearson's Chi-Square test for heterogeneity of proportions between 2017 and 2022. [c] Variable categories with a $p<0.05$ from Pearson's Chi-Square test for heterogeneity of proportions related to poor sleep quality or night shift work between 2017 and 2022.

Abbreviations: PSQI, Pittsburgh Sleep Quality Index; MW, Minimum Wages.

poor sleep quality (2017: PR = 1.41; 95% CI: 1.20–1.65; p < 0.001 / 2022: PR = 1.32; 95% CI: 1.16–1.50; p < 0.001). After controlling for confounding factors (Model IV), night shift workers had a 30% higher probability of poor sleep quality in 2017 (PR = 1.30; 95% CI: 1.10–1.55; p = 0.002) and 25% higher in 2022 (PR = 1.25; 95% CI: 1.10–1.43; p < 0.001) compared to day shift workers (Table 2).

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Table 2 Unadjusted and Adjusted Prevalence Ratios (PR) and Their Respective 95% Confidence Intervals (95% CI) for the Association Between Night Shift Work and Poor Sleep Quality (PSQI Score >5) Among Female Workers in Southern Brazil, 2017 (N=394) and 2022 (N=399)

	Poor Sleep Quality (PSQI Score >5)	Model I	Model II	Model III	Model IV
	n (%)	PR (95% CI)	PR (95% CI)	PR (95% CI)	PR (95% CI)
		p-value[a]	*p-value*[a]	*p-value*[a]	*p-value*[a]
2017 (N=394)					
Work shift					
Day shift work	163 (53.4)	1.00	1.00	1.00	1.00
Night shift work	67 (75.3)	1.41 (1.20–1.65) p<0.001	1.43 (1.22–1.67) p<0.001	1.28 (1.08–1.52) p=0.004	1.30 (1.10–1.55) p=0.002
2022 (N=399)					
Work shift					
Day shift work	202 (63.5)	1.00	1.00	1.00	1.00
Night shift work	68 (84.0)	1.32 (1.16–1.50) p<0.001	1.33 (1.17–1.51) p<0.001	1.31 (1.15–1.49) p<0.001	1.25 (1.10–1.43) p<0.001

Notes: [a]*P*-value for Wald test for heterogeneity of proportion obtained by Poisson regression with robust variance. 2017 – Model I: Unadjusted; Model II: Adjusted for age and per capita household income; Model III: Adjusted for Model II, number of daily meals, and length of employment; and Model IV: Adjusted for Model III and self-perceived health status. 2022 – Model I: Unadjusted; Model II: Adjusted for age; Model III: Adjusted for Model II, leisure-time physical activity, and current smoking status; and Model IV: Adjusted for Model III and self-perceived health status.
Abbreviation: PSQI, Pittsburgh Sleep Quality Index.

Discussion

In this study, we explored the association between night shift work and poor sleep quality in two samples of female workers from Southern Brazil (2017 and 2022). The study results showed that night shift workers had a higher probability of experiencing poor sleep quality than day shift workers. The associations observed in both studies were consistent, with a high prevalence of poor sleep quality and a significant increase in its occurrence over time.

Previous studies have indicated that shift work, particularly night shifts, is associated with a higher occurrence of poor sleep quality,[11,32,33] with this association being more pronounced in women.[11,20,31] A population-based study of women living in the subarctic region found a significantly higher likelihood of severe sleep disturbances, as classified by the PSQI, among shift workers compared to those with fixed work schedules.[31] In this context, a cross-sectional study of 3,206 nursing professionals (96% women) found that poor sleep quality, as assessed by the PSQI, is more prevalent among workers with fixed night shifts than among day workers.[41]

One possible explanation for the association between night shift work and poor sleep quality is that working night shifts can lead to delayed sleep onset behaviors. This causes desynchronization of the circadian cycle and, ultimately, poor sleep quality.[4,24,42] This desynchronization primarily occurs through hormonal dysregulation triggered by environmental stimuli associated with wakefulness during biologically programmed sleep periods.[17,43,44] In this context, the suppression of melatonin release by the pineal gland is considered a consequence of reduced exposure to natural sunlight and increased exposure to artificial light. This situation is common among night shift workers and plays a crucial role in regulating circadian rhythms.[43]

The difficulty in adapting the circadian cycle to night shift work may contribute to the development of shift work disorder,[24,45] a condition with an estimated prevalence of 26.5% (95% CI: 21.0–32.8).[46] This disorder has been associated with an increased risk of workplace accidents among night shift workers,[44] cognitive impairments,[47] reduced quality of life,[32] and several other negative health outcomes.[17,24] Beyond biological stimuli, the circadian cycle is influenced unidirectionally by behavior-driven genes and bidirectionally by environmental factors.[43] Several behaviors, including night shift work, diet, and smoking, are considered circadian disruptors. While this relationship appears to be bidirectional, circadian desynchronization may also influence behavioral changes, especially concerning eating patterns and smoking habits.[48–51] Moreover, women may experience a "double burden," as many continue to assume primary caregiving and domestic responsibilities,

which can limit opportunities for adequate sleep,[52,53] potentially exacerbating sleep disruption beyond the biological effects of shift work alone.

The prevalence of poor sleep quality identified in this study aligns with findings from a systematic review, which reported insomnia prevalence ranging from 12.8% to 76.4%. It is important to note that the methods used to assess this outcome varied across the studies included in the review.[11] Furthermore, the prevalence estimates in this study are consistent with a population-based study of women, in which 74.3% of the sample comprised workers (9.5% shift workers). This study reported a poor sleep quality prevalence of 65.5%, as classified by the PSQI.[31] Similarly, a cross-sectional study conducted in Brazil among healthcare shift workers found a higher prevalence of poor sleep quality, reaching 84.7% according to the PSQI.[54] Furthermore, another global meta-analysis indicates that sleep-related issues affect at least 30% of industrial sector workers, regardless of shift type, and at least 32% of women in this sector.[30] Additionally, the prevalence of poor sleep quality increased between 2017 and 2022. We hypothesize that the increasing prevalence of poor sleep quality may be attributed to multiple factors. A significant contributor is the heightened exposure to electronic media before bedtime, which has been widely linked to circadian rhythm disruptions and delayed sleep onset.[55,56] Furthermore, scientific literature has extensively documented the impact of the global COVID-19 pandemic in exacerbating sleep disturbances,[57,58] including a deterioration in overall sleep quality due to the COVID-19 to contribute as a risk factor for mental health.[57] Thus, the heightened prevalence of sleep disruptors during the 2020–2022 COVID-19 period—including psychosocial stress, anxiety, financial instability, and blurred boundaries between work and home life—should be taken into account when interpreting the findings.

A major strength of this study is the use of two independent samples from cross-sectional, occupational-based studies of adult women to investigate the association between work shifts and sleep quality. Although shift work has been widely studied in healthcare settings, this study contributes data from female industrial workers in Southern Brazil, thereby broadening the applicability of existing evidence to different cultural and socioeconomic contexts. In addition, the study population consisted of women employed by the same company over a five-year period, with standardized and rigorous methodological procedures ensuring data consistency and comparability. This approach facilitated the identification of increased poor sleep quality in this population group over the studied periods. All instruments were previously validated, including the Brazilian-adapted version of the Pittsburgh Sleep Quality Index (PSQI) for assessing poor sleep quality. Additionally, the key confounding factors were controlled for in the multivariable analysis. However, these findings should be interpreted with caution, as exposure and outcome were measured simultaneously, limiting causal inferences. Further longitudinal studies are recommended to establish cause-and-effect relationships more definitively. While the prevalence rates observed in our study are consistent with the existing literature, the potential influence of the healthy worker effect cannot be excluded. This bias is common in occupational research, as individuals who experience severe sleep disruption or other health problems may discontinue night shift work, resulting in a remaining group of night shift workers that is comparatively healthier. Another limitation is that leisure-time physical activity was assessed using a single item referring only to activity performed in the previous week, without consideration of duration, frequency, or intensity, which may have resulted in misclassification of physical activity levels. Future studies should incorporate more comprehensive measures of physical activity, including activity volume and potential effects on sleep patterns. Additionally, information regarding the presence of children (number and age), the use of electronic devices, and environmental conditions was not collected; therefore, future studies should consider these variables to evaluate their potential influence more comprehensively on sleep quality. It should be noted that the 2022 data collection period (August 2022 to February 2023) spanned different seasonal conditions in Southern Brazil, which may influence sleep patterns due to variations in temperature, daylight duration, and daily routines. Although seasonal effects could not be directly assessed, this potential variability should be taken into account when interpreting the findings. Another limitation to be considered is the change in the composition of the "day shift" comparison group between the two survey years. The 2017 sample included only production workers, whereas the 2022 sample also included administrative personnel. Because these groups may differ in characteristics that influence sleep, this change could have affected the temporal comparison. However, sensitivity analyses indicated that key characteristics did not differ meaningfully when administrative staff were excluded, suggesting minimal impact on the overall findings. Finally, caution is required when generalizing these results to workers with different shift schedules, such as rotating shifts, since this study focused exclusively on women in fixed (non-rotating) shifts.

Conclusion

The findings of this study indicate a persistently high prevalence of poor sleep quality, significantly associated with night shift work among female workers in Southern Brazil. Importantly, this already-high prevalence showed a statistically significant increase between 2017 and 2022, highlighting a worsening public health concern. Night shift workers had a significantly higher probability of poor sleep quality than day shift workers, with consistent associations observed across both study periods.

These results highlight the vulnerability of female night shift workers to the adverse effects of night shift work on sleep quality, underscoring the need for employers and public health policymakers to develop targeted interventions and health education initiatives aimed at improving sleep outcomes in this population. In practical terms, workplace health promotion strategies could include programs focused on sleep hygiene education, organizational adjustments to shift schedules where feasible, and the provision of designated rest areas that support restorative breaks. Additionally, interventions tailored to the specific challenges faced by female night shift workers—such as balancing employment with household and caregiving responsibilities—may help reduce the burden of sleep disturbances.

Future longitudinal research is needed to confirm these causal pathways and to evaluate the effectiveness of workplace interventions designed to mitigate sleep disturbances in this vulnerable population, for whom recovery from night shift work can be particularly challenging. Moreover, the rise in poor sleep quality between 2017 and 2022 indicates the need for further research to clarify the influence of broader contextual factors, such as increased use of digital media and worsening economic pressures, that may have contributed to this change.

Data Sharing Statement

The data that support the findings of this study are available from the corresponding author, V.M.V.P., upon reasonable request.

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Author Contributions

J.C.S: Conceptualization, Data curation, Formal analysis, Investigation, Resources, Software, Writing-original draft, Writing–review & editing. M.T.A.O: Conceptualization, Formal analysis, Investigation, Funding acquisition, Project administration, Resources, Supervision, Writing–review & editing. A.G: Conceptualization, Formal analysis, Writing-original draft. I.S.K: Conceptualization, Data curation, Investigation, Writing–review & editing. H.C.A: Conceptualization, Data curation, Investigation, Writing-original draft. R.C: Conceptualization, Writing–review & editing. V.M.V.P: Conceptualization, Formal analysis, Investigation, Writing-original draft, Writing–review & editing. All authors gave final approval of the version to be published, have agreed on the journal to which the article has been submitted, and agree to be accountable for all aspects of the work.

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Disclosure

The authors have no conflict of interest to declare.

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