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Exploration of shift work among nursing professionals related to interconnected determinants of health in a hospital: a cross-sectional study

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Abstract

Aim To explore sleep quality and its co-occurrence with interconnected health variables (perceived stress, general mental health, everyday memory complaints, and quality of life) among nursing professionals, evaluating differences across shift work, gender, and age subgroups.

Methods A cross-sectional descriptive study was conducted at Son Espases University Hospital (Spain). Data were collected between March 3 and March 24, 2025, using an online questionnaire distributed via corporate email. A total of 247 nursing professionals (85.8% female, aged 21–65) completed standardized tools: PSQI (sleep quality), MCTQ (chronotype), PSS-14 (perceived stress), GHQ-12 (general mental health), MFE-30 (memory failures), and WHOQOL-BREF (quality of life).

Results Across all shifts, participants exhibited poor sleep quality (PSQI > 5), a high prevalence of undefined chronotype (64–66%), moderate stress (~26 points), psychological distress (~14 points), and memory complaints (~58 points), while maintaining favorable quality of life (~90 points). Day-shift workers reported significantly higher sleep medication use than rotating-shift workers ($p = .011$). Subgroup analyses revealed that females on rotating shifts reported significantly more memory complaints than males ($p = .005$), and professionals over 50 years on fixed night shifts presented significantly poorer mental health ($p = .024$) and severe memory complaints ($p = .012$).

Conclusion/Implications for Practice Nursing professionals present widespread poor sleep quality, moderate stress, and subjective cognitive complaints, with greater mental health and memory vulnerability observed among females on rotating shifts and workers aged over 50 on night shifts. Rather than generic measures, organizational strategies should implement tailored shift scheduling aligned with individual chronotypes and age, integrate routine occupational monitoring of sleep and mental health, and provide targeted stress-management interventions.

Keywords: Sleep quality, Quality of life, Chronotype, Perceived stress, Memory complaints, Nursing professionals, General mental health.

1. Introduction

According to the International Labour Organization (ILO), shift work involves organizing work schedules where workers succeed one another at the same workstation, entails working at

different times, and is inherent to ensuring 24-hour patient care in hospital settings [1]. For decades, this work arrangement has been recognized to have a negative impact on workers' health and well-being [2], impacting sleep quality and circadian rhythms, and leading to fatigue as well as emotional, cognitive, and physical disturbances [3]. Currently, approximately seven out of ten nurses experience poor sleep quality [4], driven by rotating and fixed night shifts that disrupt their internal biological clock, reduce work efficiency, and compromise patient safety [5,6]. Furthermore, severe sleep disorders like insomnia remain highly prevalent among healthcare workers, heavily influenced by shift work and mental health factors [7].

Despite the extensive literature linking shift work to adverse health outcomes, such as insomnia, excessive daytime sleepiness, cardiovascular diseases, and psychological disorders [8]. Significant uncertainties remain in the current evidence base. While the allostatic load model suggests that altered sleep, chronic stress, and cognitive decline operate within a feedback loop [9], it remains unclear how these variables interact simultaneously under high-demand hospital environments. Moreover, while individual and organizational strategies (e.g., scheduling shifts or behavioral interventions) are recommended [10,11], their real-world efficacy in mitigating long-term systemic health decline is inconsistent. This uncertainty is further compounded by sociodemographic disparities; for instance, evidence shows that female nurses face a “double shift” due to unequal domestic burdens, resulting in poorer sleep quality and higher depression [12]. Furthermore, consecutive rotating night shifts are increasingly linked to severe chronic conditions, such as metabolic, cardiovascular, and oncological disorders. In the field of occupational health, recent systematic reviews, such as the one by Fagundo-Rivera *et al.* [13] in 2020, strongly support the link between prolonged night work and a 50% to 100% increase in the incidence of breast cancer among nurses. This concerning association led the International Agency for Research on Cancer (IARC) to classify night shift work as a probable human carcinogen, as exposure to artificial light disrupts circadian rhythms controlled by the suprachiasmatic nucleus, suppressing melatonin secretion and altering sex hormone modulation. Furthermore, this risk has been observed to rise significantly in early adulthood and after cumulative exposures of 5 or more years under consecutive night shift regimens. The precise compounding effect of these combined gender-specific and occupational stressors requires further clarification.

At the biological level, the internal mechanism affected by shift work involves environmental stressors interfering with the suprachiasmatic nucleus (SCN) and disrupting

melatonin secretion rhythms [14,15]. Although the roles of primary zeitgebers like light [16] and secondary zeitgebers like routine or physical activity [17] are well-mapped individually, the unresolved mechanism lies in the complex, non-linear interaction within the broader domain of “interconnected health variables” [18]. In this mechanistic context, recent systematic evidence underscores that prolonged night work triggers complex physiological cascades, including alterations in epigenetic markers like telomere shortening, changes in reproductive hormones (such as progesterone and estrogen), and an elevated expression of peripheral clock genes. Crucially, within the occupational health framework, it is well established that health outcomes do not depend solely on isolated biological paths, but rather on a complex interplay across biological, psychosocial, economic, and organizational domains. The core mechanistic uncertainty lies in how these multidimensional domains interact dynamically; for instance, the pathways through which a single organizational stressor (such as shift-work exposure) cascades concurrently into psychological distress, memory complaints, and a decline in general health within the same cohort remain a mechanistic black box [13]. Taken together, the evidence suggests that shift work does not act through a single pathway but through a network of interacting biological and psychosocial processes whose joint behavior remains poorly characterized. Moreover, it is still unclear how a single alteration, like sleep latency, triggers a systemic cascade that impacts everyday memory, psychological well-being, and overall health within the same cohort.

While previous research has linked shift work to adverse outcomes such as insomnia, circadian disruption, and psychological distress [8,11], critical uncertainties remain regarding how these factors interact concurrently. According to the allostatic load framework, altered sleep, chronic stress, and cognitive complaints operate within a dynamic feedback loop rather than through isolated pathways [9]. However, most empirical studies examine sleep deprivation or emotional burnout as independent consequences, failing to capture how these biological, psychosocial, and cognitive domains covary as an interconnected network within the same cohort of healthcare workers [19]. Furthermore, the compounding effects of sociodemographic factors (such as age-related vulnerability and gender-specific occupational burdens) remain insufficiently characterized in high-demand hospital environments.

To address these gaps, this study examines the co-occurrence of sleep quality with perceived stress, mental health, memory complaints, and quality of life among nursing staff, applying a multidimensional analytical approach.

The main objective of this study was to explore sleep quality and its co-occurrence with interconnected health variables (perceived stress, general mental health, everyday memory complaints, and quality of life) among nursing professionals, evaluating differences across shift work, gender, and age subgroups at a level III hospital.

The specific objectives were: 1) To describe subjective sleep quality using the Pittsburgh Sleep Quality Index (PSQI) and to characterize the chronotype of nursing professionals through the Munich Chronotype Questionnaire (MCTQ); 2) To estimate the levels of perceived stress (PSS-14), self-perceived general mental health (GHQ-12), everyday memory failures (MFE-30), and professional quality of life (WHOQOL-BREF) within this cohort; and 3) To explore differences in these interconnected health variables across subgroups of nursing professionals based on shift type (day, night, and rotating), gender, and age (≤ 50 vs. > 50 years).

Methods

Design, Participants, and Setting

A quantitative, cross-sectional descriptive observational study was conducted at Hospital Universitario Son Espases (HUSE) and its affiliated centers (General Hospital, Psychiatric Hospital, and Virgen de la Salud Hospital), level III reference healthcare institutions in the Balearic Islands, Spain. Sample size calculation was performed using GRANMO (v.7.12). Based on an expected population proportion of 2%, a 95% confidence level, and a precision of $\pm 3\%$, a minimum sample size of 81 participants was required. Anticipating a 15% attrition rate, the target sample size was set at 95 participants per professional category. Ultimately, a non-random convenience sample of 247 nursing professionals (155 nurses and 92 certified nursing assistants) completed the study across day, night, and rotating work shifts (Table 1). The inclusion criteria were: (a) nursing professionals (registered nurses and certified nursing assistants) with at least one month of work experience in any unit at HUSE; (b) age between 18 and 65 years; and (c) temporary, interim, or permanent employment status. The minimum criterion of one month of experience was selected because it represents the standard timeframe required for healthcare staff to complete a full monthly shift rotation schedule and encounter its acute circadian and physical demands, while simultaneously filtering out transient or short-term relief staff whose acute onboarding stress might confound baseline measures. Exclusion criteria were: (a) diagnosed primary sleep disorders; (b) experiencing a major negative life event in the preceding two months

(e.g., bereavement, severe personal or financial crisis, major illness); (c) active sick leave or returning from sick leave less than one month prior; (d) documented substance abuse or regular intake of prescribed hypnotics/sedatives; (e) conflicts of interest with the unit or department where the participant works or with the institution; and (f) incomplete survey submissions.

Table 1 Classification of work shifts in hospitals.

SHIFT WORK and SUBGROUPS	
Day	Morning shift (8:00 – 15:00 h)
	Afternoon shift (15:00 – 22:00 h)
	12-hour day shift (8:00 – 20:00 h)
	Mixed shift (week of morning shift-week of afternoon shift)
Night	Night shift (22:00 – 8:00 h)
Rotating	2-morning, 2-afternoon, 1-night, 1-day outgoing, 2-day off
	12-hour shift (8:00 – 20:00 h and 20:00 – 8:00 h)

Measures and instruments

Data were collected using a unified online survey, created with Microsoft 365® Forms, which integrated validated Spanish versions of standardized instruments. In addition to collecting sociodemographic variables and occupations (age, gender, professional category, work shift, and years of professional experience).

The following instruments provided information on the primary variable: Pittsburgh Sleep Quality Index (PSQI)[20,21], which evaluates subjective sleep quality over the previous month across seven components (total score ranges from 0 to 21, with scores > 5 indicating poor sleep quality). Secondary variables included: Perceived Stress Scale (PSS-14)[23,24], which measures subjective perception of stress over the past month (range 0-56; higher scores indicate higher stress); General Health Questionnaire (GHQ-12)[25,26], which screens for psychological distress and minor psychiatric morbidity (scores > 12 indicate potential distress); Memory Failures in Everyday Life (MFE-30)[27,28], which assesses subjective memory complaints in daily situations (scores range from 0 to 90; higher scores reflect greater perceived impairment); World Health Organization Quality of Life (WHOQOL-BREF)[29,30], which evaluates physical, psychological, social, and

environmental quality of life domains (transformed scale 0–100; higher scores indicate superior quality of life); and Munich Chronotype Questionnaire (MCTQ)[22], which assesses sleep-wake schedules on workdays and free days to determine individual chronotypes. It has proven to be a reliable and valid measure, sensitive to variables such as age, gender, and lifestyle [33].

Procedure

Data collection took place between March 3 and 24, 2025. To ensure voluntary participation and preserve anonymity, the link to the online survey was distributed exclusively by the Teaching and Research Department of the Nursing Directorate of the hospital via the institutional corporate email system. The research team did not have access to mailing lists, email addresses, or employees' personal information at any time.

Data Analysis

Data processing and statistical analyses were performed using IBM SPSS Statistics (v.30.0). Completed questionnaire responses were automatically exported from Microsoft Forms into Excel and inspected for missing values and logical consistency prior to analytical entry.

Normality and homoscedasticity were formally tested using Shapiro-Wilk, Kolmogorov-Smirnov, and Levene's tests. Due to non-normal distributions across major outcome scales, non-parametric inferential statistical methods were applied. Continuous variables are summarized using means (***M***), standard deviations (***SD***), and 95% confidence intervals (**95% CI**). Categorical variables are reported as absolute percentages and frequencies (**%**, ***n***).

Bivariate associations between sleep quality, stress, general mental health, memory complaints, and quality of life across shift groups were evaluated using Spearman's rank correlation coefficient (**ρ**). Differences between independent groups (shift modalities, gender, and age categories ≤ 50 vs. > 50 years) were tested using the Mann-Whitney ***U*** test (for two groups) and the Kruskal-Wallis test (for three groups). Effect sizes were calculated using rank-biserial correlation (**r_{rb}**) for two-group comparisons and epsilon-squared (**ϵ^2**) for multi-group comparisons. Pairwise post-hoc comparisons were adjusted using the Bonferroni correction. Statistical significance was set at two-tailed **$p < .05$** .

Ethical aspects and data security

The study protocol strictly adhered to the ethical principles of the Declaration of Helsinki and Spanish Law 14/2007 on Biomedical Research. The research was formally reviewed and approved by the Research Committee of Hospital Universitario Son Espases (Approval No. CI-989-25) and the Research Ethics Committee for Medicinal Products of the Balearic Islands (CEIm-IB; Approval No. IB 5724/25 PI).

Prior to accessing the online questionnaire, participants were presented with an electronic information sheet detailing the study objectives, voluntary nature, and absence of commercial or financial conflicts of interest. Informed consent was obtained electronically via a mandatory checkbox before proceeding to the survey items. Complete anonymity and confidentiality were guaranteed; no IP addresses, email accounts, or personal names were captured. Data handling strictly complied with the EU General Data Protection Regulation (GDPR 2016/679) and Spanish Organic Law 3/2018 (LOPDGDD). Survey design and web reporting followed the CHERRIES guidelines for web-based surveys [31].

Results

The results obtained in this study are shown below, based on the data collected and analyzed after completing the questionnaires and scales answered by the nursing professionals.

Socio-demographic data

Table 2 presents the socio-demographic and occupational data of the 247 participants in the study, distributed according to type of work shift (day, night, or rotating).

Table 2 Descriptive analysis of participants' sociodemographic data in relation to shift work.

Sociodemographic data (N: 247)		Shift work		
		Day 38.5% (95)	Night 4.5% (11)	Rotating 57.1% (141)
Gender	Males 14.2% (35)	10.5% (10)	27.3% (3)	15.6% (22)
	Females 85.8% (212)	89.5% (85)	72.7% (8)	84.4% (119)
Age	21 to 30 years 10.90% (28)	9.5% (9)	9% (1)	12.8% (18)
	31 to 40 years 19.5% (44)	12.6% (12)	18.2% (2)	24.1% (34)
	41 to 50 years 29.9% (74)	30.5% (29)	36.4% (4)	29.1% (41)
	More than 50 years 39.2% (97)	47.4% (45)	36.4% (4)	34% (48)

Professional category	Nurses	61.1% (58)	27.3% (3)	47.5% (67)
	CNAs	38.9% (37)	72.7% (8)	52.5% (74)
Years of experience	6 months to 1 year	1% (1)	0% (0)	0.7% (1)
	1 to 5 years	9.5% (9)	18.2% (2)	14.9% (21)
	5 to 10 years	8.4% (8)	27.3% (3)	20.6% (29)
	More than 10 years	81.1% (77)	54.5% (6)	63.8% (90)

Note: CNAs, nursing assistant technicians

The study analyzed a sample of 247 participants, mostly women (85.8%) and predominantly over 41 years old. The rotating shift was the most common (57.1%), followed by the day shift (38.5%) and the night shift (4.5%). Staffing was evenly split between nurses and assistants, though assistants held 72.7% of the night shift positions. Most of the workforce had over 10 years of experience, mainly concentrated in the day and rotating shifts. In terms of location, 85.1% of the participants worked at HUSE, leaving less than 7.3% for the other hospitals.

Results of the statistical analyses of the primary and secondary variables

Table 3 presents the results of the primary and secondary variables with respect to the 247 participants distributed according to the types of work shifts (day, night, and rotating).

Table 3 Inferential analysis: Results of the interconnected health variables in relation to shift work.

Shift work	Day n = 95	Night n = 11	Rotating n = 141		
Males	10 (10.53%)	3 (27.27%)	22 (15.60%)		
Females	85 (89.47%)	8 (72.73%)	119 (84.40%)		
	M (SD) [95% CI]	M (SD) [95% CI]	M (SD) [95% CI]	<i>p</i>	ε^2
PSQI	9.81 (4.20) [8.95, 10.67]	10.09 (4.11) [7.33, 12.85]	8.78 (3.66) [8.17, 9.39]	.252	0.003
PSS-14	26.88 (6.42) [25.58, 28.19]	28.36 (5.88) [24.41, 32.32]	26.26 (6.27) [25.22, 27.31]	.606	0.004
GHQ-12	13.94 (6.65) [12.58, 15.29]	13.55 (7.42) [8.56, 18.53]	12.52 (5.23) [11.65, 13.39]	.533	0.003
MFE-30	58.26 (21.49) [53.88, 62.64]	60.18 (25.94) [42.75, 77.61]	55.95 (18.37) [52.89, 59.01]	.874	0.007
WHOQOL	89.35 (13.70) [86.56, 92.14]	90 (16.35) [79.01, 100.99]	92.01 (12.43) [89.94, 94.08]	.498	0.002

Note: PSQI, Pittsburgh Sleep Quality Index Questionnaire; PSS-14, Perceived Stress Scale; WHOQOL-BREF, World Health Organization Quality of Life Questionnaire; GHQ-12, General Health Questionnaire; MFE-30, Memory Complaints in Everyday Life Questionnaire; M, mean; SD, Standard deviation; CI, Confidence Interval; n, sample size; *p* with significance levels: $p < .001$ (high), $p < .01$ (medium), $p < .05$ (low); ε^2 , epsilon squared (effect size): $\varepsilon^2 < .01$ (small effect), ε^2 between .06 and .14 (medium effect), $\varepsilon^2 > .14$ (large effect) [32]

The study found no statistically significant differences in sleep quality (PSQI), mental health (GHQ-12), or memory complaints (MFE-30) across shifts. Mean stress scores (PSS-14) were also similar among groups, though the rotating shift exhibited the widest range of extreme values (0-42). Regarding quality of life (WHOQOL-BREF), the rotating shift achieved the highest mean score (92.01), followed by the day and night shifts. The night shift presented the lowest quality of life average (86.35) alongside the highest dispersion in data distribution (16.35). Conversely, the rotating shift maintained the lowest standard deviation (12.43) despite capturing the widest overall score variations in stress.

Pittsburgh Sleep Quality Index (PSQI)

Figure 1 shows the results obtained on the different components of the PSQI according to the participants' work shift (day, rotating, or night).

Figure 1 Results of the PSQI components in relation to shift work.

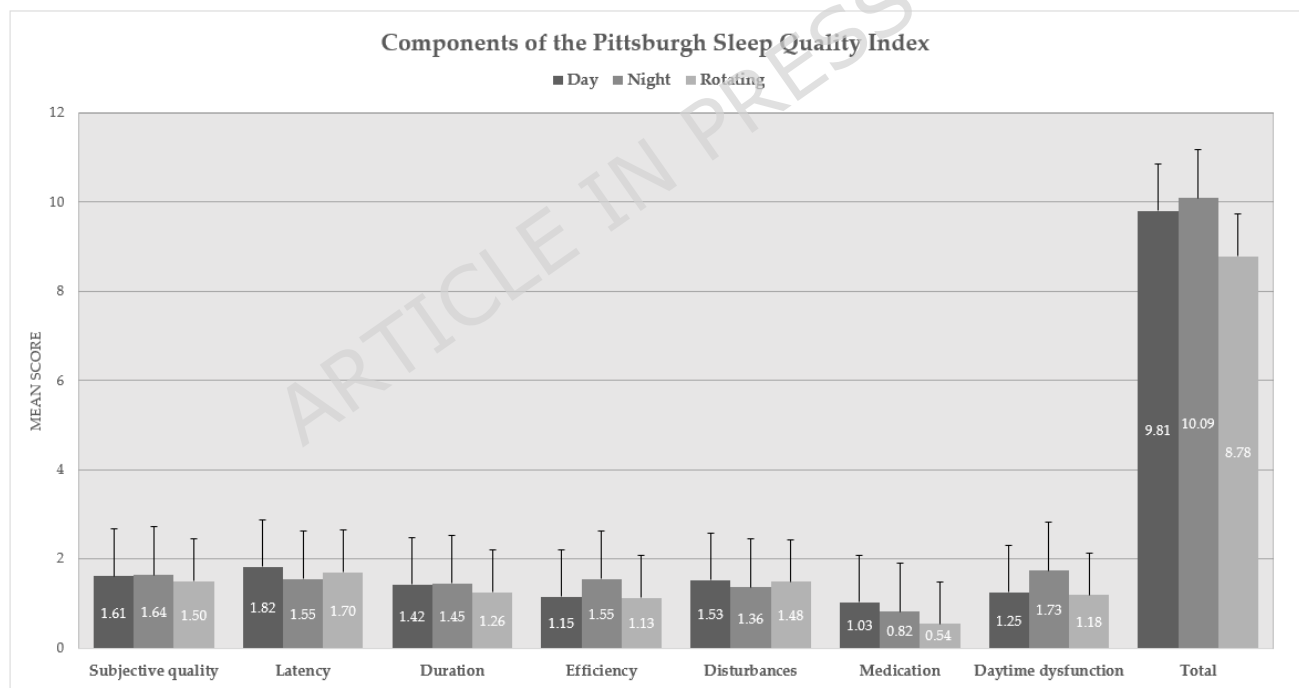


Table 4 represents the mean values, standard deviations, range, mean contrast (p), and effect size (ϵ^2) of the PSQI components, as well as the total score according to shift work (day, night, or rotating).

The PSQI component analysis revealed significant differences between shifts only regarding sleep medication use ($p = .011$, $\varepsilon^2 = .028$). The day shift recorded the highest mean score for this component (1.03), followed by the night (0.82) and rotating (0.59)

Table 4 Inferential analysis: Results of sleep quality components and PSQI total score in relation to shift work.

Shift work	Day n = 95	Night n = 11	Rotating n = 141		
PSQI COMPONENTS	M (SD) [95% CI]	M (SD) [95% CI]	M (SD) [95% CI]	<i>p</i>	ε^2
Subjective Quality	1.61 (0.74) [1.46, 1.76]	1.64 (0.80) [1.09, 2.18]	1.50 (0.68) [1.38, 1.61]	.449	.001
Latency	1.82 (0.92) [1.63, 2.01]	1.55 (1.21) [0.73, 2.36]	1.70 (0.94) [1.54, 1.85]	.498	.002
Duration	1.42 (0.72) [1.27, 1.57]	1.45 (0.82) [0.90, 2.01]	1.26 (0.78) [1.12, 1.39]	.180	.005
Efficiency	1.15 (1.09) [0.93, 1.37]	1.55 (1.36) [0.63, 2.46]	1.13 (1.04) [0.95, 1.30]	.635	.004
Disturbances	1.53 (0.58) [1.41, 1.64]	1.36 (0.67) [0.91, 1.82]	1.48 (0.60) [1.38, 1.58]	.543	.003
Medication	1.03 (1.29) [0.77, 1.29]	0.82 (1.25) [0.00, 1.66]	0.54 (0.98) [0.37, 0.70]	.011	.028
Daytime Dysfunction	1.25 (0.95) [1.06, 1.45]	1.73 (0.64) [1.29, 2.16]	1.18 (0.86) [1.04, 1.33]	.125	.008
Score Total	9.81 (4.20) [8.95, 10.67]	10.09 (4.11) [7.33, 12.85]	8.78 (3.66) [8.17, 9.39]	.252	.003

Note: PSQI, Pittsburgh Sleep Quality Index; M, mean; SD, Standard Deviation; CI, Confidence Interval; n, sample size; *p* with significance levels: $p < .001$ (high), $p < .01$ (medium), $p < .05$ (low); ε^2 , epsilon squared (effect size): $\varepsilon^2 < .01$ (small effect), ε^2 between .06 and .14 (medium effect), $\varepsilon^2 > .14$ (large effect) [32]

shifts. No statistically significant variations were observed among the remaining components of the sleep quality index across the groups. Post-hoc Mann-Whitney U tests with Bonferroni correction adjusted the significance threshold for further pairwise comparisons to $p < .016$. Ultimately, only the day versus rotating shift comparison proved significant ($p = .003$), showing higher medication use in rotating shifts.

Chronotype

Table 5 shows the distribution of chronotypes in the total sample and according to work shift.

Table 5 Results of the percentage distribution and direct scores of the chronotypes in relation to shift work.

Chronotype subtypes	Shift work		
	Day 38% (89)	Night 5% (11)	Rotating 58% (136)
Extreme morning	1% (1)	9% (1)	4% (5)
Morning	28% (25)	9% (1)	24% (32)
Indefinite	66% (59)	45% (5)	64% (88)
Evening	2% (2)	18% (2)	4% (5)
Extreme evening	2% (2)	18% (2)	4% (6)

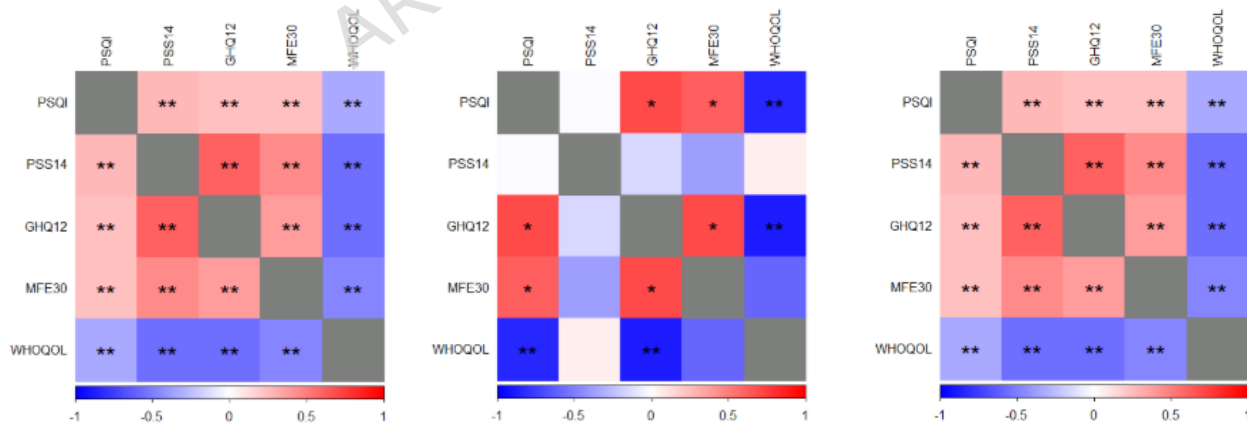
Note: Initially, data was collected from 247 participants, but 11 responses were removed because they were not answered correctly. Therefore, the result was for a final sample of 236 participants to explore the chronotype of nursing professionals

In the total sample, the indefinite chronotype predominated (64%), followed by the morning type (25%). The day shift mirrored this trend, with a predominance of indefinite (66%) and morning (28%) chronotypes. Conversely, the night shift showed a high presence of evening (18%) and extreme evening (18%) types. Finally, the rotating shift was led by the indefinite chronotype (64%), followed by the morning type (24%).

Correlations of health variables interconnected to shift work

Figures 2A (day shift), **2B** (night shift), and **2C** (rotating shift) show the correlations (ρ) between sleep quality (PSQI), perceived stress (PSS-14), general mental health (GHQ-12), memory complaints (MFE-30), and quality of life (WHOQOL-BREF) in relation to shift work.

Figure 2A Day shift **Figure 2B** Night shift **Figure 2C** Rotating shift



Note: **, the correlation is significant at the .01 level (bilateral); *, the correlation is significant at the .05 level (bilateral)

For the day shift, poor sleep quality and high stress significantly correlated with poorer mental health and lower quality of life. Stress in this group is also strongly linked to more memory complaints and a steeper decline in overall quality of life. The night shift showed the strongest negative ties, where poor sleep and poor mental health heavily compromised quality of life. Mental health in night workers was also heavily intertwined with a higher number of subjective memory complaints. The rotating shift mirrored these patterns, showing consistent correlations between high stress, poor mental health, and memory issues.

Table 6 represents the mean values, standard deviation, range, mean contrast (p), and effect size (r_{rb}) of the different interconnected health variables in relation to gender.

Table 6 Inferential analysis: Results of interconnected health variables in relation to shift work and gender differences.

Shift work	Gender	Male 10 (10.53%)	Female 85 (89.47%)	p	r_{rb}
		M (SD) [95% CI]	M (SD) [95% CI]		
Day (n = 95)	PSQI	8.70 (4.32) [5.61, 11.79]	9.94 (4.19) [9.04, 10.85]	.364	.093
	PSS-14	25.30 (8.74) [19.05, 31.55]	27.07 (6.13) [25.75, 28.39]	.627	.050
	GHQ-12	13.90 (8.54) [7.79, 20.01]	13.94 (6.46) [12.55, 15.33]	.488	.071
	MFE-30	49.40 (18.99) [35.81, 62.99]	59.31 (21.63) [54.64, 63.97]	.152	.147
	WHOQOL	90 (14.92) [79.33, 100.67]	89.27 (13.64) [86.33, 92.21]	.851	.019
		3 (27.27%)	8 (72.73%)		
Night (n = 11)	PSQI	10.33 (3.21) [2.35, 18.32]	10 (4.59) [6.16, 13.84]	.921	.062
	PSS-14	28.67 (3.05) [21.08, 36.26]	28.25 (6.84) [22.53, 33.97]	.630	.185
	GHQ-12	16.33 (6.11) [1.16, 31.51]	12.50 (7.96) [5.84, 19.16]	.376	.278
	MFE-30	52 (22.91) [-4.92, 108.92]	63.25 (27.79) [40.01, 86.49]	.497	.216
	WHOQOL	81 (4.58) [69.62, 92.38]	93.38 (18.12) [78.22, 108.53]	.194	.432
		22 (15.60%)	119 (84.40%)		
Rotating (n = 141)	PSQI	8.09 (3.50) [6.54, 9.64]	8.91 (3.69) [8.24, 9.58]	.314	.085
	PSS-14	25 (4.52) [22.99, 27.01]	26.50 (6.53) [25.31, 27.68]	.185	.112
	GHQ-12	12.91 (4.11) [11.08, 14.73]	12.45 (5.42) [11.46, 13.43]	.359	.077
	MFE-30	46.64 (13.24) [40.76, 52.51]	57.67 (18.71) [54.27, 61.07]	.005	.237
	WHOQOL	92.05 (10.24) [87.50, 96.59]	92 (12.83) [89.67, 94.33]	.964	.003

Note: PSQI, Pittsburgh Sleep Quality Index; PSS-14, Perceived Stress Scale; WHOQOL-BREF, World Health Organization Quality of Life Questionnaire; GHQ-12, General Health Questionnaire; MFE-30, Memory Complaints in Everyday Life Questionnaire; M, mean; SD, Standard Deviation; CI, Confidence Interval; n, sample size; p with significance levels: $p < .001$ (high), $p < .01$ (medium),

$p < .05$ (low); r_{rb} , rank biserial correlation (effect size): $r_{rb} < .3$ small effect, r_{rb} between .30 to .50 medium effect, $r_{rb} > .50$ large effect [32]

Gender analysis revealed significant differences within the rotating shift only for memory complaints ($p = .005$), where women scored higher than men. The effect size for this specific variable was small, while it remained practically negligible for all other evaluated health indicators. No statistically significant differences between genders were observed in any other variables, regardless of the assigned work shift.

Table 7 represents the mean values, standard deviation, range, mean contrast (p), and effect size (r_{rb}) of the different interconnected health variables in relation to age.

Table 7 Inferential analysis: Results of interconnected health variables in relation to shift work and differences by age (≤ 50 and > 50 years).

Shift work	Age	≤ 50 years 50 (52.63%)	> 50 years 45 (47.37%)	p	r_{rb}
		M (SD) [95% CI]	M (SD) [95% CI]		
Day (n = 95)	PSQI	9.12 (3.62) [8.09, 10.15]	10.58 (4.67) [9.17, 11.98]	.187	.156
	PSS-14	27.14 (6.64) [25.25, 29.03]	26.60 (6.23) [24.73, 28.47]	.617	.059
	GHQ-12	14.12 (6.33) [12.32, 15.92]	13.73 (7.06) [11.61, 15.86]	.415	.096
	MFE-30	58.36 (20.63) [52.50, 64.22]	58.16 (22.65) [51.35, 64.96]	.743	.039
	WHOQOL	88.58 (14.28) [84.52, 92.64]	90.20 (13.13) [86.25, 94.15]	.416	.096
		7 (63.63%)	4 (36.36%)		
Night (n = 11)	PSQI	8.43 (2.07) [6.51, 10.34]	13 (5.47) [4.28, 21.72]	.230	.403
	PSS-14	28.29 (6.29) [22.47, 34.10]	28.50 (6.02) [18.91, 38.09]	.927	.057
	GHQ-12	9.43 (3.99) [5.73, 13.12]	20.75 (6.55) [10.33, 31.17]	.024	.656
	MFE-30	46 (13.11) [33.87, 58.13]	85 (24.69) [45.70, 124.30]	.012	.742
	WHOQOL	95.14 (13.32) [82.82, 107.46]	81 (19.16) [50.50, 111.50]	.164	.457
		93 (65.96%)	48 (34.04%)		
Rotating (n = 141)	PSQI	8.38 (3.36) [7.68, 9.07]	9.56 (4.09) [8.37, 10.75]	.076	.149
	PSS-14	26.61 (6.73) [25.23, 28]	25.58 (5.26) [24.05, 27.11]	.312	.085
	GHQ-12	13.17 (5.58) [12.02, 14.32]	11.25 (4.25) [10.01, 12.49]	.047	.167
	MFE-30	56.41 (19.62) [52.37, 60.45]	55.06 (15.84) [50.46, 59.66]	.998	.001
	WHOQOL	92.58 (13.11) [89.88, 95.28]	90.90 (11.03) [87.69, 91.10]	.444	.065

Note: PSQI, Pittsburgh Sleep Quality Index; PSS-14, Perceived Stress Scale; WHOQOL-BREF, World Health Organization Quality of Life Questionnaire; GHQ-12, General Health Questionnaire; MFE-30, Memory Complaints in Everyday Life Questionnaire; M, mean; SD, Standard Deviation; CI, Confidence Interval; n, sample size; p with significance levels: $p < .001$ (high), $p < .01$ (medium), $p < .05$ (low); r_{rb} , rank biserial correlation (effect size): $r_{rb} < .3$ small effect, r_{rb} between .30 to 0.50 medium effect, $r_{rb} > .50$ large effect [32]

Age analysis revealed that day and night shift nurses over 50 had significantly worse mental health, alongside more memory complaints in the night shift. Conversely, the rotating shift showed the opposite trend, with nurses under 50 reporting significantly poorer mental health outcomes. No other significant differences were found for sleep quality, stress, or quality of life, despite minor non-significant trends in sleep.

Discussion

The main objective of this study was to explore sleep quality and its co-occurrence with interconnected health variables (perceived stress, general mental health, everyday memory complaints, and quality of life) among nursing professionals, evaluating differences across shift work, gender, and age subgroups at a level III hospital. Overall, the findings suggest that poor sleep quality, moderate perceived stress, psychological distress, and memory complaints coexist across the nursing workforce, regardless of shift assignment. Rather than identifying marked differences between work schedules, the data reveal a shared profile of vulnerability affecting professionals exposed to the demands of contemporary hospital care. This observation is particularly relevant because it challenges the traditional assumption that adverse outcomes are concentrated exclusively among night workers. Instead, our findings indicate that sleep-related vulnerability may operate as a transversal occupational phenomenon shaped by both organizational and individual determinants. This interpretation is consistent with recent evidence showing that sleep disturbances are highly prevalent among nurses irrespective of the specific scheduling system adopted [4,7,19,34].

The absence of significant differences in global PSQI scores between shifts should not be interpreted as evidence of an absence of occupational impact. On the contrary, the uniformly elevated sleep disturbance observed across all groups may indicate that environmental and organizational stressors have become sufficiently pervasive to affect the entire nursing workforce. The hospital environment is characterized by exposure to multiple challenges, including workload, time pressure, staff shortages, emotional demands, and irregular recovery opportunities. These stressors interact with biological sleep regulation mechanisms and may contribute to chronic sleep disruption independently of shift type [3,11,33,34].

Recent occupational health research increasingly emphasizes that sleep disturbances emerge from the cumulative interaction of psychosocial, organizational, and circadian factors rather than from shift timing alone [51,52]. Furthermore, the correlation patterns observed in the

present study support the concept that sleep quality functions as a central node connecting psychological well-being, perceived stress, cognitive complaints, and quality of life. This multidimensional perspective aligns with contemporary models of occupational health, which conceptualize sleep as both an outcome and a determinant of workers' overall health status [18,53].

One of the most unexpected findings was the higher use of sleep medication among day-shift professionals compared with rotating-shift workers. At first glance, this result appears counterintuitive because circadian disruption is traditionally associated with rotating or night schedules [5,11]. A plausible explanation is that sleep difficulties among day workers may arise from mechanisms different from those experienced by night staff. Early morning schedules often require awakening at biologically unfavorable times, leading to chronic sleep restriction despite apparently conventional working hours. In addition, family responsibilities, caregiving obligations, and domestic workload) which disproportionately affect women in healthcare settings (may reduce opportunities for restorative sleep and promote the use of pharmacological sleep aids [12,41]. Another possibility is that professionals who remain in fixed daytime positions represent a subgroup with pre-existing sleep difficulties or accumulated occupational stress, which cannot be detected through a cross-sectional design. Recent studies have shown that sleep medication use among healthcare workers is not always directly associated with night work but may reflect chronic psychological strain, anxiety symptoms, or maladaptive coping strategies [7,42]. Consequently, these findings highlight the need to assess sleep health comprehensively, extending beyond the traditional focus on night-shift personnel.

The predominance of the undefined chronotype observed in this sample deserves specific consideration. Although morning chronotypes represented the second most frequent category, nearly two-thirds of participants exhibited intermediate chronobiological profiles. This distribution may reflect the adaptive pressures imposed by prolonged exposure to shift systems. Occupational schedules frequently require workers to override their natural circadian preferences, potentially blurring chronotype expression over time. Similar findings have been reported among healthcare professionals exposed to long-term shift work, suggesting a mismatch between endogenous rhythms and externally imposed schedules [38,40]. Interestingly, evening and extreme evening chronotypes appeared more frequently among night-shift workers. This pattern is biologically plausible because individuals with delayed circadian timing may experience less circadian

misalignment when working during the night [39,40]. However, circadian adaptation should not be interpreted as complete protection from adverse outcomes. Even when chronotype is compatible with work schedules, repeated exposure to artificial light at night, social jet lag, and irregular recovery periods may continue to generate physiological strain and sleep deficits [11,15]. Consequently, chronotype-informed scheduling could mitigate (but not eliminate) the negative consequences of shift work.

The consistent associations observed between sleep quality, stress, mental health indicators, and memory complaints can be interpreted within the framework of the Allostatic Load Model proposed by McEwen [45]. According to this model, chronic exposure to stressors activates adaptive physiological responses that become maladaptive when sustained over time. Sleep disruption, psychological stress, cognitive complaints, and emotional distress should therefore be viewed not as isolated phenomena but as interconnected manifestations of cumulative biological burden. At the neurobiological level, circadian disruption may alter hypothalamic-pituitary-adrenal axis functioning, increase cortisol secretion, promote systemic inflammation, and impair hippocampal processes involved in memory consolidation [11,45]. Recent evidence also suggests that prolonged sleep restriction is associated with neurocognitive dysfunction, impaired executive performance, and subjective memory failures among healthcare professionals [43,44,54].

The strong correlations observed between stress, psychological distress, and memory complaints support the hypothesis that these domains form part of a common adaptive pathway driven by repeated occupational demands. Although causality cannot be inferred, the observed network is highly compatible with contemporary models of allostatic overload and occupational burnout [12,53].

The identification of greater memory complaints among women working rotating shifts reinforces previous literature describing gender-based inequities in occupational health [12,41]. Female nurses frequently experience the cumulative effects of professional responsibilities and unpaid domestic work, commonly referred to as the "double burden." This phenomenon may amplify sleep restriction, emotional exhaustion, and cognitive fatigue, independently of direct workplace exposures. Consequently, the higher memory complaints reported by women may

reflect the combined influence of biological, psychosocial, and organizational determinants rather than purely occupational factors.

Age-related findings also merit attention. Night-shift professionals older than 50 years displayed poorer mental health and more severe memory complaints than younger colleagues. These results are consistent with evidence suggesting that aging reduces circadian flexibility and diminishes the ability to adapt to nocturnal schedules [50]. Additionally, age-related changes in sleep architecture, slower physiological recovery, and cumulative exposure to occupational stress may increase vulnerability among older workers. From an occupational health perspective, this subgroup may require specific preventive strategies and greater flexibility in shift allocation.

A particularly noteworthy finding is that participants generally reported favorable levels of quality of life despite poor sleep quality, moderate stress, and psychological vulnerability. This apparent paradox may be interpreted through the resilience paradigm. Nursing professionals often develop adaptive coping mechanisms, strong professional identity, meaningful interpersonal relationships, and a sense of purpose that buffer the subjective perception of reduced well-being despite exposure to chronic stressors [55]. Rather than indicating the absence of risk, favorable quality-of-life scores may therefore reflect successful adaptation to demanding work environments. However, resilience should not be interpreted as invulnerability. A positive subjective perception of well-being may coexist with physiological dysregulation and cumulative biological burden that remain undetected until later stages of disease development [45]. Consequently, relying exclusively on quality-of-life indicators may underestimate underlying occupational risks.

Beyond immediate effects on sleep, cognition, and mental health, the present findings should be interpreted within the broader context of long-term occupational health. Extensive evidence indicates that chronic circadian disruption contributes to metabolic dysfunction, cardiovascular disease, immunological imbalance, and cancer susceptibility [11,13]. Exposure to artificial light during the biological night suppresses melatonin secretion, alters endocrine regulation, disrupts clock-gene expression, and promotes physiological conditions linked to chronic disease development [13,15]. Recent reviews continue to support concerns regarding

prolonged night-shift exposure and cumulative carcinogenic risk, particularly among women employed in healthcare professions for extended periods [56,57].

Although the present study was not designed to evaluate oncological outcomes, the coexistence of poor sleep, stress, and psychological distress observed in this cohort may represent early manifestations of biological strain associated with long-term health deterioration. From a preventive perspective, occupational health interventions should therefore move beyond symptom management and adopt a systemic approach incorporating sleep promotion, chronotype-informed scheduling, psychological support programs, and longitudinal monitoring of high-risk professionals. Such strategies are increasingly recommended by international occupational health frameworks as essential components of sustainable healthcare workforce management [11,52,58].

Limitations

This study presents some limitations and barriers that should be taken into account. First, the cross-sectional design prevents establishing causal relationships between the variables analyzed. Second, the use of self-administered questionnaires may involve social desirability bias or recall errors. Third, a balanced sample with equal sizes was not presented, using an estimated sample size calculation. This reduced statistical power and increases the risk of Type II error, so any lack of significance should be interpreted with caution. However, this distribution was free of selection bias and accurately reflects the hospital's organizational reality. To preserve internal validity in the face of this lack of homogeneity, rigorous non-parametric analysis was applied. Fourth, the sample, although large, corresponds to a single hospital and its associated centers, which could limit the generalization of the results to other healthcare settings.

Strengths and Future research

A major strength of this study lies in its large, representative sample of nurses and certified nursing assistants from a tertiary hospital, evaluated through internationally validated instruments (PSQI, MCTQ, PSS-14, GHQ-12, MFE-30, WHOQOL-BREF) and a network analysis approach that captured the interconnected nature of occupational health dimensions. To build upon these empirical findings, future research should pursue six strategic directions. First, longitudinal prospective designs are needed to clarify causal pathways between perceived stress, sleep latency, and cognitive complaints over time. Second, sample expansion across specific subgroups

(particularly fixed night shifts) will increase statistical power to confirm the observed trends. Third, experimental studies and clinical trials should evaluate tailored interventions aligned with our empirical findings: investigating non-work stressors driving sleep-medication use in day-shift staff, testing cognitive protection strategies for night-shift nurses over 50 showing severe mental and memory decline, and addressing the double burden in female rotating-shift workers reporting elevated memory failures. Fourth, incorporating objective monitoring tools, such as actigraphy and circadian biomarkers (e.g., melatonin), will complement self-reported scales and reduce recall bias. Fifth, targeted funding should support clinical trials evaluating strategic napping or chronotype-adjusted scheduling. Finally, future methodologies must rigorously control for external cultural, domestic caregiving, and organizational confounders to ensure robust conclusions. Ultimately, translating sleep science into institutional policy requires shifting from generic advice to targeted strategies addressing age, gender, and shift-specific vulnerabilities.

Implications for Nursing & Health Policy

The empirical findings of this study offer actionable evidence to guide organizational decision-making and occupational risk prevention in hospital settings. Rather than applying generic measures, policy recommendations must be directly aligned with the specific vulnerabilities identified across shift profiles. First, occupational health services should tailor intervention strategies to high-risk subgroups: addressing underlying daytime anxiety and non-work-related stressors in day-shift staff given their higher sleep-medication use; implementing age-adjusted scheduling or voluntary night-shift opt-out policies for nurses over 50 due to their pronounced mental and cognitive decline; and introducing gender-sensitive scheduling to mitigate the combined occupational and domestic caregiving burden associated with memory lapses in female rotating-shift workers. Second, institutions should integrate standardized screening tools (e.g., PSQI and GHQ-12) into routine health surveillance to enable early detection of sleep, emotional, and cognitive distress before they impact patient safety or increase sick leave. Finally, nursing management must adopt evidence-informed scheduling that limits high-density rotations and facilitates strategic rest breaks, supported by institutional training programs in sleep hygiene and stress management to empower staff in circadian self-care.

Conclusions

This observational study highlights complex interrelationships between shift work schedules, sleep quality, stress, and well-being among nursing staff. The widespread observation of poor sleep quality across all shifts, along with the unexpected higher use of sleep medication among daytime workers, suggests a baseline vulnerability that may transcend shift-specific factors. Furthermore, the co-occurrence of specific chronotypes within certain shifts, alongside the distinct patterns of mental health and memory complaints observed in older nurses and women on rotating shifts, underscores the multi-factorial nature of these phenomena. While poorer sleep quality co-varied with lower quality of life, particularly during night shifts, overall quality of life perceptions remained favorable. Given the inherent limitations of observational design, these findings describe significant associations and trends rather than causal links. Nevertheless, these descriptive patterns suggest that incorporating individual characteristics, such as chronotypes and age, into organizational scheduling could be a supportive strategy for staff well-being.

Declarations

Abbreviations

CEIm-IB: Research Ethics Committee for Medicinal Products of the Balearic Islands (Comité de Ética de la Investigación con Medicamentos de las Islas Baleares).

CHERRIES: Checklist for Reporting Results of Internet E-Surveys.

CI-HUSE: Research Committee of Hospital Universitario Son Espases.

CNA: Certified Nursing Assistant (Nursing care assistant).

COVID-19: Coronavirus Disease 2019.

EU: European Union.

GDPR: General Data Protection Regulation.

GHQ-12: General Health Questionnaire (12-item version).

GRANMO: Sample size calculator program (Programa para el cálculo del tamaño de la muestra).

HUSE: Son Espases University Hospital (Hospital Universitario Son Espases).

IARC: International Agency for Research on Cancer.

IBM: International Business Machines Corporation.

IDISBA: Health Research Institute of the Balearic Islands (Instituto de Investigación Sanitaria de las Islas Baleares).

ILO: International Labour Organization.

IUNICS: University Institute for Research in Health Sciences (Instituto Universitario de Investigación en Ciencias de la Salud).

LOPDGDD: Organic Law on the Protection of Personal Data and Guarantee of Digital Rights (Ley Orgánica de Protección de Datos Personales y Garantía de los Derechos Digitales).

M: Mean (Arithmetic mean).

MCTQ: Munich Chronotype Questionnaire.

MFE-30: Memory Failures of Everyday Life Questionnaire (30-item version).

N / *n*: Total sample size / Subsample size.

NRL: Functional and Clinical Neurophysiology: Biological Rhythms and Language group.

p: p-value (Statistical significance level).

PSQI: Pittsburgh Sleep Quality Index.

PSS-14: Perceived Stress Scale (14-item version).

r_{rb}: Rank biserial correlation (Effect size coefficient).

SCN: Suprachiasmatic Nucleus.

SD: Standard Deviation.

SPSS: Statistical Package for the Social Sciences (IBM software).

UIB: University of the Balearic Islands (Universidad de las Islas Baleares).

WHOQOL: World Health Organization Quality of Life Questionnaire.

WHOQOL-BREF: World Health Organization Quality of Life-BREF Questionnaire (Abbreviated version).

ϵ^2 : Epsilon squared (Effect size coefficient).

ρ : Spearman's rank correlation coefficient (Spearman's rho).

Ethical approval

This study was conducted in accordance with the Declaration of Helsinki and approved by the Hospital Research Committee under decision number CI-989-25 (approved on January 27, 2025), the Research Ethics Committee for Medicinal Products of the Balearic Islands under decision number IB 5724/25 PI (approved on March 26, 2025), and the nursing management of HUSE. Participants provided informed consent via a disclaimer after receiving detailed information about the study's voluntary purpose. The principal investigator guaranteed absolute anonymity, privacy, and confidentiality for all personal data collected during the research.

Consent for publication

All participants obtained prior written consent to participate and publish anonymous quotes. No identifying information will be disclosed.

Data Availability

All data generated or analyzed during this study are available from the corresponding author with a reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest.

Author Contributions

JARD: Writing – review & editing, Writing – original draft, Visualization, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. SFS: Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Data curation. FC: Writing – review & editing, Writing – original draft, Visualization, Supervision, Resources, Project administration, Methodology, Investigation, Conceptualization. AG: Writing – review & editing, Writing – original draft, Visualization, Supervision, Resources, Project administration, Methodology, Investigation, Conceptualization. MA: Writing – review & editing, Writing – original draft, Visualization, Supervision, Resources, Project administration, Methodology, Investigation, Conceptualization. CN: Writing – review & editing, Writing – original draft, Visualization, Supervision, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. All authors have read and agreed to the published version of the manuscript.

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