



Identifying Individual Determinants for Sleep Intervention Preferences among Middle-Aged Nurses



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Nurses are at risk of poor sleep health and may be an important target population for sleep interventions. However, little is known about the factors predicting preferences for different sleep intervention types or deliveries. This current study examined the relationship between diverse factors (e.g., sociodemographics, sleep hygiene knowledge, personality) and preferences for various sleep interventions. The data was collected from 86 outpatient nurses. Participants provided their sociodemographic information and completed questionnaires assessing their personality traits, sleep hygiene knowledge and preferences for sleep intervention types and deliveries. Nearly all participants were interested in participating in a sleep intervention (99%). The preferred sleep intervention type among respondents was mindfulness-based training (74%), while an online format (88%) was the most favored delivery method. Those with lower incomes and lower agreeableness were associated with endorsing sleep hygiene education more frequently. Nurses who had more than one child, provided sleep hygiene tips to patients, and demonstrated higher levels of openness and agency were inclined to endorse mindfulness-based training. For sleep intervention delivery, nurses who worked longer hours and nurses who did not provide sleep hygiene tips to patients favored group meetings more highly. Being White Hispanic or a person of color was associated with a higher endorsement of one-on-one meetings. Finally, nurses of a younger age and being a single child parent were associated with a higher endorsement for an online format delivery of sleep interventions. Findings from this study may help inform the planning, recruitment, and implementation of future interventions aimed to improve sleep health in nurses, and further, in other vulnerable healthcare workers.

INTRODUCTION

Poor sleep health is a public health epidemic that negatively affects people of all ages worldwide. There are numerous physical and mental health effects of poor sleep health including deficits in cognitive performance, poor work productivity, and early mortality (Hublin et al. 2007; Gingerich et al. 2017; Wardle-Pinkston et al. 2019). Nurses are especially vulnerable to poor sleep because of a great deal of psychological and physical stress they experience from work. For instance, they treat critically ill patients

and engage in physical labor at work (e.g., extensive walking, lifting patients, and spending long hours on their feet) (Mealer et al. 2006; Walters and Dick 2015). The consequences of occupational stress can adversely impact their sleep and subsequently their work performance and patient care (Stimpfel et al. 2020). An emerging line of research is studying healthcare workers' willingness to engage in and preferences for sleep interventions (Lee et al. 2020a; Lee et al. 2020b). More research is needed, however, to determine whether nurses have more specific preferences for sleep interventions depending on their individual characteristics. This study examined the relationship between nurses' sociodemographic factors, personality traits, and sleep hygiene knowledge to determine if they are associated with preferences for different sleep intervention types and deliveries.

The Behavioral Model of Health Services Use

The Behavioral Model of Health Services Use elucidates that there are a multitude of individual and societal factors that enable or impede health service utilization (Andersen 1995). The model is intended to promote equitable access to healthcare by understanding who and why people use health services (Andersen 1995). Broadly, the model categorizes determinants into three categories, including predisposing, enabling, and need. Inherent characteristics

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(e.g., sociodemographics) and mental factors (e.g., attitudes, beliefs and knowledge about health and health service) are considered predisposing factors that influence healthcare utilization (Andersen 1995; Andersen and Newman 2005). As for enabling factors, this takes into consideration the financial and organizational influences like one's income, health insurance and source of care (Andersen 1995; Andersen and Newman 2005). Finally, need factors refer to an individual's self-realization of health and illness status or the evaluated health condition and care needs by healthcare professionals (Andersen 1995; Andersen and Newman 2005). Despite the suggested trichotomized factors in the Andersen model, it has been noted that there may be an overlap between factors (e.g., education has been categorized as predisposing and enabling) (Babitsch et al. 2012). In line with the literature, the current study uses the Behavioral Model of Health Services Use as a theoretical framework to uncover potential factors associated with preferences for sleep interventions.

Regarding sociodemographic characteristics, age, sex, race and ethnicity, education, marital status, work hours and parent status are classified as predisposing factors in this study in accordance with previous studies (Andersen 1995; Andersen and Newman, 2005; Babitsch et al. 2012). For example, non-Hispanic White individuals are more likely to receive medical treatment compared to people belonging to other ethnic and racial groups (Andersen et al. 2002; Blackwell et al. 2009; Dhingra et al. 2010; Babitsch et al. 2012). Considering sex, women are more likely than men to visit a physician and use healthcare services, including diagnostic screenings and nutrition counseling (National Academy of Sciences, Engineering, and Medicine 2018; Parslow et al. 2002; Dhingra et al. 2010). While most sociodemographic characteristics are categorized into predisposing factors, income is generally considered an enabling factor for healthcare utilization and was classified as such in this study (Andersen and Newman 2005; Babitsch et al. 2012). To illustrate, studies have found that individuals with higher incomes are more likely to contact doctors and access alcohol, drug, and mental health care services compared to those with lower incomes (Blackwell et al. 2009; Stockdale et al. 2007).

Furthermore, although personality traits and knowledge of sleep hygiene have not been directly mentioned in the original Andersen behavioral model, past findings suggest that these factors may be related to personal predisposing characteristics under the subcategory of beliefs, attitudes, and knowledge of health (Andersen 1995; Andersen and Newman 2005; Babitsch et al. 2012). Previous studies have established the relationship between personality traits (i.e., openness, conscientiousness, extraversion, agreeableness, agency, neuroticism) and medical service use because personality dictates one's beliefs and behaviors (den Boeft

et al. 2016; Danoff-Burg et al. 2006; Israel et al. 2014). For instance, people who are more conscientious and agreeable are more likely to pursue preventive care (Ingledew and Brunning 1999; Armon and Toker 2013; Israel et al. 2014). In regards to health knowledge, it has been shown that poor disease knowledge and health literacy are associated with higher use of healthcare services (Berkman et al. 2011; Valery et al. 2022). Accordingly, those who perceive the seriousness of illnesses or the impact of health behaviors may be more likely to endorse health education or service.

Focus on Nurses

Previous research has reported a high prevalence of poor sleep health among nurses. In a study of U.S. hospitals, the participating nurses had an average sleep efficiency of 85.6% (James et al. 2020). Although a sleep efficiency of 85% or above is considered healthy among people younger than 60, it suggests that nurses barely reach the minimum on average and there may be some who do not reach the minimum (Desjardins et al. 2019). With the COVID-19 pandemic, nurses experienced numerous psychological and physical stressors which worsened their sleep health (Sagherian et al. 2020), and, approximately, 71% reported sleep disturbances (Simonetti et al. 2021). Accordingly, addressing nurses' sleep concerns is important because poor sleep may hinder their health and work performance. For example, on average, 50% of nurses sleep less than 7 hours or less before a workday (Stimpfel et al. 2020), which is associated with poorer quality care and lower patient safety (Gingerich et al. 2017). These findings suggest that sleep interventions are needed to support nurses' health and thus patient care.

Previous Interventions Targeting Sleep

Research on the availability, efficacy, and implementation of sleep interventions is lacking. From the small number of studies conducted, interventional practices for nurses include bright-light exposure, nap breaks, and schedule rearrangements, yet their efficacies are uncertain (Querstret et al. 2019). Conducting interventions at the individual and institutional levels, like targeting sleep hygiene knowledge and establishing workplace policies or strategies (e.g., frequent breaks), may be the optimal approach for improving sleep (Sun et al. 2018). For instance, a study revealed that a two-hour session on sleep hygiene education improved sleep problems in shift nurses (Yazdi et al. 2018). Mindfulness-based interventions are also suitable for nurses to manage stress and pre-sleep cognitive arousal (Cincotta et al. 2010). An online seven-week mindfulness-based stress reduction intervention improved the scores of subjective sleep quality, sleep latency, and habitual sleep efficiency among nurses (Nourian et al. 2021). Moreover, a randomized clinical trial observed a large improvement in sleep-related quality



of life in participants with insomnia symptoms after an eight-week digital cognitive-behavioral therapy for insomnia (CBT-I) intervention (Espie et al. 2019). However, understanding the influential factors on nurses' preferences for sleep interventions may be critical in identifying suitable sleep interventions for them.

Current Study

Guided by the Behavioral Model of Health Services Use, this exploratory study will uncover whether sociodemographic factors, sleep hygiene knowledge, and personality are associated with the nurses' preferences for a sleep intervention by type and delivery (Andersen 1995). By analyzing these determinants in the context of sleep-intervention endorsement, more effective interventions can be implemented in the future. The current study will contribute new knowledge delineating how predisposing and enabling factors influence preferences for different sleep intervention types and deliveries, particularly in a population that is vulnerable to poor sleep like nurses.

METHODS

Procedure and Participants

This study was part of a larger project investigating sleep health among nurses. Data collection occurred between June and September 2020. Outpatient nurses were recruited from a cancer center hospital located in a large metropolitan city. Nurse managers emailed the study brochure to the nurses' LISTSERV. Interested participants reached out to the study team and completed a Google form to screen for eligibility. Eligible participants were at least 18 years of age, worked at least 30 hours per week, worked regular day shifts (but not split, variable, or rotating shifts) and owned a smartphone.

Participants completed a background survey, 14-day ecological momentary assessment (EMA) and 14-day sleep actigraphy. The background survey and EMA were administered using a smartphone-based application called RealLife Exp (LifeData 2012), which is why possessing a smartphone was a screening criterion. For the current study, we used data from the background survey only. The survey took approximately 15 to 20 minutes to complete and inquired about sociodemographic and economic factors, and psychological and behavioral information. In total, 86 outpatient nurses completed the background survey. Detailed descriptions of the study protocol can be found in a previous publication (Vigoureux et al. 2022).

Measures

Sociodemographic factors included age, sex (0=Female, 1=Male), race/ethnicity (0=Non Hispanic White, 1=White Hispanics or persons of color), education (0=4 years of college or more, 1=Less than 4 years of college), income,

marital status (0=Single, 1=Married/Living with a permanent romantic partner), parent status (0=Not a parent, 1=Parent of 1 child, 2=Parent of 2 or more children) and work hours. Age, income and work hours were continuous variables and centered at the sample mean.

Participants responded to a 15-item sleep hygiene knowledge questionnaire (Gallasch and Gradisar 2007). They would indicate if the statements, such as "If you cannot fall asleep in 20 minutes, you should get out of bed and try again later," were true or false with the additional option of selecting Don't know (0=False, 1=True, 2=Don't Know). If participants answered correctly (True/False), then they received 2 points. If participants answered incorrectly (True/False), then they received -2 points. If participants responded, "Don't Know", then they received 0 points. A composite score of all responses was calculated and ranged from -30 to 30, with higher numbers indicating better sleep hygiene knowledge. Participants were also asked whether they provided sleep hygiene tips to their patients (0=No, 1=Yes).

Personality traits were assessed using the Midlife Development Inventory (MIDI) Personality Scales (Lachman and Weaver 1997). Participants were asked, "Please indicate how well each of the following [characteristics] describes you: 1=Not at all, 2=A little, 3=Some, 4=A lot." Example items included outgoing, helpful, and moody. Based on how participants responded to the 30 characteristics, they were then scored on six personality traits: openness, conscientiousness, extraversion, agreeableness, neuroticism and agency. Higher values reflected greater alignment with the personality domain. Cronbach alphas were .64, .42, .72, .65, .74 and .80 for openness, conscientiousness, extraversion, agreeableness, neuroticism, and agency, respectively.

Finally, participants were asked if they would be interested in participating in a sleep intervention without any financial cost on their part. To probe their interest, participants were asked to endorse different sleep intervention types and deliveries. The sleep intervention types presented were sleep hygiene education, mindfulness-based training or CBT-I (0=No, 1=Yes). Sleep intervention deliveries were group meetings at the workplace, one-on-one meetings at a clinic, or online (0=No, 1=Yes).

Statistical Analyses

Data management and analyses were conducted in SAS v9.4. The following variables were treated continuously: age, income, work hours, sleep hygiene knowledge composite score, openness, conscientiousness, extraversion, agreeableness, neuroticism and agency. The rest of the variables were recoded categorically, according to the parameters in the parentheses in the "Measures" section. Relative risks (RR) tests were used to assess the likelihood of the individual determinants being associated with the different sleep inter-



vention types and delivery formats (Zhang and Kai 1998). PROC GENMOD with a Modified Poisson distribution was used for estimations of relative risks because the outcomes were binary, and this is the recommended procedure for outcomes with a prevalence of 10% or more (Zhang and Kai 1998; Zou 2004; Zhao 2013). The threshold for significance was $p < .05$.

Model 1 examined the relationship between sociodemographic variables and sleep intervention types and deliveries. Sociodemographic variables were treated as covariates in subsequent models because previous studies have shown that they are related to sleep health (Grandner 2019). Model 2 examined the relationship between sleep knowledge (sleep hygiene knowledge and providing tips to patients, each in separate models) and sleep intervention types and deliveries. Model 3 examined the relationship between personality traits and sleep intervention types and deliveries. Each personality trait was added in separate models. The two outcomes, sleep intervention type and delivery, were run in separate models.

RESULTS

Sample Characteristics

The sample characteristics of our main variables consist of participants' sociodemographic factors, work hours, presence of sleep concerns and preferences for sleep interventions (Table 1). The mean age was 46 years, and the sample was predominantly female (93%) and non-Hispanic White (61%). Participants were well-educated (87% had 4 years of college or more). Similarly, 80% had an annual household income ranging between \$60,000 to \$159,000. More than half of the participants were married or lived with a romantic partner (63%). About 24% had one child and 22% had at least two children under the age of 18 living with them at least four days a week. The nurses worked an average of 39 hours per week. The majority reported a sleep concern (78%) and almost all were interested in participating in a sleep intervention (99%). For sleep intervention type, mindfulness-based training was the most preferred type (74%), followed by sleep hygiene education (66%), and CBT-I (55%). For sleep intervention delivery, most participants preferred an online format (88%), and an equal amount preferred group or one-to-one meetings (22%).

Factors Associated with Preferences for Sleep Intervention Types

The relative risk results for the three models were significant for sleep hygiene education and mindfulness-based training, but not for CBT-I (Table 2). Model 1 included sociodemographic characteristics and revealed that those with lower incomes were 10% more likely to endorse sleep hygiene education (RR = 0.90, 95% CI [0.82, 0.99], $p = .04$). Additionally, parents of two or more children were 33% more likely to

endorse a mindfulness based intervention (RR = 1.33, 95% CI [1.01, 1.75], $p = .04$). No other variables in the sociodemographic model were significant.

In Model 2, participants who provided sleep hygiene tips to their patients were 30% more likely to endorse a mindfulness-based intervention (RR = 1.30, 95% CI [1.004, 1.67], $p = .047$). In Model 3, participants with lower agreeableness were 46% more likely to endorse a sleep hygiene education intervention (RR = 0.54, 95% CI [0.33, 0.90], $p = .02$). Lastly, those who scored higher in openness and agency were 51% (RR = 1.51, 95% CI [1.04, 2.19], $p = .03$) and 45% (RR = 1.45, 95% CI [1.14, 1.85], $p = 0.003$) more likely to endorse a mindfulness-based intervention, respectively.

Factors Associated with Preferences for Sleep Intervention Delivery Formats

The relative risk results for the three sleep-intervention delivery options - group meetings, one-on-one meetings, or online delivery, were only significant in Models 1 and 2 (Table 3). In Model 1, nurses who worked longer hours were associated with a 17% higher likelihood of endorsing a group meeting for a sleep intervention (RR = 1.17, 95% CI [1.03, 1.32], $p = .01$). Moreover, those who identified as White Hispanics or persons of color were 228% more likely to prefer one-on-one meetings (RR = 3.28, 95% CI [1.38, 7.80], $p = .01$). Parents with one child were 19% more likely to endorse an online meeting format (RR = 1.19, 95% CI [1.04, 1.37], $p = .01$). Contrarily, with every yearly decrease in age, participants were 1% more likely to endorse an online meeting for a sleep intervention (RR = 0.99, 95% CI [0.98, 0.998], $p = .02$). In Model 2, the only significant relationship was between sleep hygiene tips and group meetings. Nurses who did not share sleep hygiene tips with their patients had a 70% higher likelihood of engaging in a group sleep intervention (RR = 0.30, 95% CI [0.11, 0.83], $p = .02$). Lastly, in Model 3, there were no statistically significant relationships between personality traits and sleep intervention delivery formats.

DISCUSSION

The purpose of this study was to examine if nurses' sociodemographic factors, sleep hygiene knowledge, and personalities influenced their preferences for a specific sleep intervention by type and delivery. The exploratory approach of this study was guided by the Behavioral Model of Health Services Use, which explains how predisposing, enabling, and need factors influence healthcare utilization (Andersen 1995). By incorporating sleep health into the model, this study aimed to disclose individual determinants for sleep intervention endorsement. We identified significant associations across the sociodemographic, sleep knowledge, and personality traits concerning sleep hygiene education and

Table 1. Sample Characteristics

Variables	M (SD) or n (%)
Sociodemographic Variables	
Age	45.91 (11.0)
Sex (female)	80 (93.0%)
Non-Hispanic White	52 (60.5%)
Education (4 years of college or more)	75 (87.2%)
<i>Annual Household Income</i>	
Less than 40,000	0 (0.0%)
40,000 - 59,999	6 (7.0%)
60,000 - 79,999	19 (22.1%)
80,000 - 99,999	15 (17.4%)
100,000 - 119,999	15 (17.4%)
120,000 - 139,999	10 (11.6%)
140,000 - 159,999	10 (11.6%)
160,000 - 179,999	5 (5.8%)
180,000 - 199,999	3 (3.5%)
More than 200,000	3 (3.5%)
Married/Partnered	54 (62.8%)
<i>Has Children</i>	
None	46 (53.5%)
One	21 (24.4%)
Two or more	19 (22.1%)
Work Hours	38.87 (4.9)
Sleep Intervention Variables	
Sleep Concern	67 (77.9%)
Sleep Intervention Interest	85 (98.8%)
<i>Preference for Sleep Intervention Type</i>	
Sleep Hygiene Education	57 (66.3%)
Mindfulness-Based Training	64 (74.4%)
Cognitive-Behavioral Therapy	47 (54.7%)
<i>Preference for Sleep Intervention Delivery</i>	
Group	19 (22.4%)
One-on-one	19 (22.4%)
Online	75 (88.4%)

Note: The outpatient nurses who participated in this study (N = 86) provided their sociodemographic information and responded to questions assessing their interest in sleep interventions. Abbreviations: M = mean, SD = standard deviation, n = frequency, % = percentage.

Table 2. Endorsement for a Sleep Intervention Type

	Sleep Intervention Type											
	Sleep Hygiene Education				Mindfulness-Based Training				Cognitive Behavioral Therapy			
	RR	Lower CI	Upper CI	p	RR	Lower CI	Upper CI	p	RR	Lower CI	Upper CI	p
Model 1. Sociodemographic Characteristics												
Age	0.99	0.98	1.01	.29	1.00	0.99	1.02	.72	1.00	0.99	1.02	.67
Male	0.74	0.32	1.70	.48	0.95	0.53	1.67	.85	0.80	0.37	1.75	.58
White Hispanics & Persons of Color	0.97	0.71	1.32	.85	0.93	0.70	1.23	.61	1.03	0.69	1.54	.88
Education	1.18	0.80	1.72	.40	0.84	0.55	1.28	.42	1.37	0.81	2.33	.25
Income	0.90	0.82	0.99	.04	1.00	0.92	1.08	.94	0.89	0.78	1.01	.07
Work Hours	0.99	0.95	1.03	.58	1.03	0.99	1.07	.14	0.99	0.93	1.06	.86
Partnered	0.97	0.68	1.40	.88	0.79	0.57	1.09	.15	1.30	0.82	2.07	.26
Parent with 1 Child	0.99	0.72	1.35	.93	0.98	0.69	1.38	.90	0.90	0.55	1.47	.67
Parent with 2 or More Children	0.82	0.51	1.30	.40	1.33	1.01	1.75	.04	0.87	0.53	1.43	.57
Model 2. Sleep Hygiene Knowledge												
Providing Sleep Hygiene Tips to Patients	0.85	0.64	1.13	.26	1.30	1.004	1.67	.047	1.11	0.75	1.63	.61
Sleep Hygiene Knowledge	1.00	0.98	1.02	.86	1.00	0.98	1.02	.87	1.02	0.98	1.06	.30
Model 3. Personality												
Openness	0.96	0.58	1.60	.89	1.51	1.04	2.19	.03	0.92	0.51	1.66	.78
Conscientiousness	0.79	0.50	1.24	.30	0.82	0.55	1.24	.35	0.55	0.30	1.01	.054
Extraversion	0.97	0.74	1.27	.82	1.28	0.98	1.69	.07	0.94	0.63	1.40	.75
Agreeableness	0.54	0.33	0.90	.02	0.81	0.52	1.25	.34	1.21	0.58	2.51	.61
Neuroticism	1.14	0.91	1.42	.26	1.04	0.87	1.25	.66	0.99	0.70	1.40	.96
Agency	0.96	0.75	1.22	.74	1.45	1.14	1.85	.003	1.09	0.77	1.55	.61

Note: Participants' likelihoods for endorsing a sleep intervention by type based on their sociodemographic characteristics, sleep hygiene knowledge, and personality traits were calculated with Modified Poisson distribution. Model 2 and Model 3 were adjusted for the sociodemographic factors tested in Model 1. The values in bold denote a significant relationship ($p < .05$) between a variable in one of the models and a sleep intervention type. Abbreviations: RR = Relative Risk, CI = Confidence Interval.

mindfulness-based training but not for CBT-I. Regarding preferences for intervention delivery formats, sociodemographic factors were the most influential determinants compared to sleep knowledge and personality traits, such that they were associated with preferences for group meetings, one-on-one meetings, and online delivery. The sleep knowledge model presented one significant relationship with group meetings while the personality model was not significant for any of the intervention delivery formats. Nonetheless, taken together, these findings suggest that nurses' individual determinants impact their healthcare preferences in the context of sleep interventions. This study may assist future investigations

exploring the underlying reasons for endorsing specific sleep interventions and examining their effectiveness to improve nurses' sleep health.

Sleep Hygiene Education

The results showed that a higher income was negatively associated with a lower endorsement of sleep hygiene education. Compared to those with a higher income, people with a lower income may be more likely to endorse this type of sleep intervention because it may teach them how to follow the guidelines of a sleep hygiene education while considering their limited access to resources and other barriers; for

Table 3. Endorsement for a Sleep Intervention Delivery Format

	Sleep Intervention Delivery Format											
	Group Meetings				One-on-One Meetings				Online Meetings			
	RR	Lower CI	Upper CI	p	RR	Lower CI	Upper CI	p	RR	Lower CI	Upper CI	p
Model 1. Sociodemographic Characteristics												
Age	1.02	0.97	1.07	.49	1.00	0.96	1.04	.98	0.99	0.98	0.998	.02
Male	1.37	0.16	12.00	.77	3.33	0.70	15.98	.13	0.89	0.62	1.28	.53
White Hispanics & Persons of Color	1.89	0.86	4.15	.11	3.28	1.38	7.80	.01	0.94	0.79	1.11	.47
Education	1.41	0.49	4.03	.52	0.41	0.09	1.80	.24	1.03	0.72	1.46	.88
Income	1.01	0.80	1.27	.92	1.18	0.95	1.47	.13	0.99	0.95	1.03	.48
Work Hours	1.17	1.03	1.32	.01	1.01	0.88	1.16	.85	0.99	0.97	1.01	.37
Partnered	0.54	0.20	1.48	.23	0.38	0.14	1.04	.06	1.23	1.00	1.51	.050
Parent of 1 Child	0.70	0.21	2.34	.56	2.07	0.81	5.29	.13	1.19	1.04	1.37	.01
Parent of 2 or More Children	0.71	0.19	2.70	.62	0.94	0.35	2.51	.90	1.13	0.93	1.36	.21
Model 2. Sleep Hygiene Knowledge												
Providing Sleep Hygiene Tips to Patients	0.30	0.11	0.83	.02	1.15	0.50	2.66	.74	1.06	0.91	1.23	.45
Sleep Hygiene Knowledge	0.97	0.94	1.01	.14	0.97	0.92	1.03	.32	1.01	1.00	1.02	.28
Model 3. Personality												
Openness	1.17	0.37	3.69	.79	2.76	0.96	7.93	.06	1.09	0.85	1.41	.48
Conscientiousness	0.42	0.13	1.42	.16	1.05	0.27	4.07	.94	1.01	0.79	1.28	.96
Extraversion	1.69	0.73	3.93	.22	2.26	0.94	5.44	.07	0.89	0.77	1.03	.11
Agreeableness	0.34	0.09	1.21	.09	2.70	0.51	14.45	.25	0.93	0.67	1.29	.68
Neuroticism	0.97	0.49	1.96	.94	0.72	0.38	1.35	.30	0.94	0.81	1.08	.37
Agency	1.27	0.55	2.92	.57	2.20	0.91	5.32	.08	0.91	0.80	1.03	.13

Note: Participants' likelihoods for endorsing a sleep intervention by delivery format based on their sociodemographic characteristics, sleep hygiene knowledge, and personality traits were calculated with Modified Poisson distribution. Model 2 and Model 3 were adjusted for the sociodemographic factors tested in Model 1. The values in bold denote a significant relationship ($p < .05$) between a variable in one of the models and a sleep intervention delivery format. Abbreviations: RR = Relative Risk, CI = Confidence Interval.

instance, they may be less capable of creating a good sleep environment, establishing physical activity routines, accessing healthy foods, and lessening their stress from job strains (Rottapel et al. 2020). Accordingly, nurses with lower incomes might have endorsed sleep hygiene education, which can help them surpass their troubles in implementing sleep hygiene strategies into their living contexts.

Likewise, the personality trait of agreeableness exhibited an inverse relationship with sleep hygiene education. This was unexpected because people with such traits generally tend to be willing and adaptable when faced with situations, like choosing healthy lifestyle choices (Crowe et al. 2017;

Allen et al. 2015). Agreeableness may operate differently in this sample as the average agreeableness was relatively high ($M = 3.72$, Range: 2.80-4.00), and may not have been sensitive enough to detect differences among those who are less agreeable. Regardless, a potential reason behind this relationship may be that nurses who score higher in agreeableness may have higher personal accountability at work or other areas of their lives (e.g., family or social obligations), motivating them to follow more engaging self-care interventions (McGarrigle & Walsh 2011; Drach-Zahavy & Srulovici 2018; Haliwa et al. 2021). Nurses with more agreeable personalities may recognize that they will



individually benefit from another type of sleep intervention.

Mindfulness-Based Training

Nurses who are parents of two or more children were more likely to endorse mindfulness based training. Such association may be attributed to working parents' acknowledgment of the benefits of mindfully handling multiple responsibilities to mitigate stress and role conflict (Allen et al. 2012). However, parents with one child interestingly did not exhibit this positive association. This may be due to second-child parents having increased parenting role overload and time pressure with multiple responsibilities, and consequently, a decline in mental health compared to first and only-child parents (Ruppanner et al. 2018). Nurses who have two or more children may thus be more attracted to a mindfulness-based intervention than one-child parents as means to manage their mental health in the context of work-family balance and, in turn, improve their sleep.

In the sleep knowledge model, providing sleep hygiene tips to patients was positively associated with endorsing a mindfulness-based intervention. These nurses may have chosen mindfulness-based training over sleep hygiene education, particularly, because they may already have the knowledge to recommend or implement healthy sleep behaviors. Therefore, they may perceive that mindfulness-based training has greater benefit. However, there is no research to our knowledge supporting this conjecture.

Lastly, higher openness to experience and higher agency were two personality traits that were associated with a higher likelihood of endorsing mindfulness-based training. People who are more open to experiences may be more willing to engage in this type of intervention which is intellectually imaginative (Barner et al. 2011). Those with higher openness also tend to be non judgmental, which is a key feature of practicing mindfulness (Epstein 1999; Barner et al. 2011). Similarly, individuals with a greater sense of agency may be more inclined to engage in a mindfulness-based intervention because they may have greater self-efficacy to control their thoughts and stress levels and be present in the moment, further reinforcing their sense of agency (Glanz and Bishop 2010; Hunter 2016). In essence, nurses who are more open to experiences and have greater agency may endorse mindfulness-based training because they may be more welcoming and curious to explore an imaginative intervention and have the capacity to learn how to control their mind and thus their sleep, respectively.

Cognitive Behavioral Therapy for Insomnia (CBT-I)

CBT-I was the least favored sleep intervention type by participants. Fewer participants may have chosen CBT-I over the other types of interventions due to the intensive nature (i.e., time-consuming) of this type of sleep intervention, which can further exacerbate their work-related problems as nurses

(Natsky et al. 2020). Also, CBT-I may not be among the popular non-pharmacological methods for sleep intervention because there are not sufficient qualified healthcare providers that are trained to deliver CBT-I or have insufficient time to be involved (van der Zweerde et al. 2016). Such intensiveness and lack of accessibility may deter those willing to engage in a sleep intervention from choosing CBT-I. The majority of this study's participants also did not report being diagnosed with insomnia, which could further explain why fewer people chose CBT-I as a sleep intervention. Lastly, since CBT-I was the least preferred intervention, this outcome hence potentially explains why none of the individual determinants from the sociodemographic factors, sleep hygiene knowledge, and personality models were associated with CBT-I endorsement.

Group Meetings

The results demonstrated that nurses who did not provide sleep hygiene tips to their patients were more likely to endorse group meetings for a sleep intervention. These nurses may see group meetings as an opportunity to learn sleep hygiene tips and practices from their co-workers, considering they share similar work hours, work environments, tasks, workload and work-related stressors (Skar 2010; Steffen et al. 2015).

Contrary to the result from the sleep knowledge model, longer work hours were positively associated with a higher endorsement of group meetings at the workplace in the sociodemographic model. It was expected at first that nurses working longer hours would prefer an online intervention because of its scheduling flexibility. Yet, at the same time, these nurses may be interested in sharing ideas on sleep health improvement with other co-workers who also have long work hours (Romppanen and Häggman-Laitila 2016; Tran et al. 2018). Working longer hours may further allow nurses more available time at work to engage in group meetings for a sleep intervention.

One-on-One Meetings

Another interesting finding within the sociodemographic model indicates that participating nurses who identified themselves as White Hispanics or persons of color are more likely to endorse one-on-one meetings. A potential reasoning behind this finding may regard these participants pertaining to a racial and/or ethnic minority group that has faced a history of healthcare disparities. Due to the longstanding societal, economic and environmental inequities in healthcare, racial and ethnic minorities struggle to find and receive quality care based on their specific needs and build trust with their providers (Cooper et al 2002). A one-on-one healthcare intervention, in turn, may seem attractive because it may establish interpersonal trust and allows for time to extensively share personal experiences



(Cooper et al. 2002; Wahbeh et al. 2014a). Accordingly, this group of nurses may endorse one-on-one meetings because the interventionists can provide individualized, sympathizing, and culturally tailored care while considering the framework of intersectionality (Chin et al. 2007; Sabatino et al. 2012).

Online

The online delivery format was the most preferred by the participants, with group and one-on-one meetings being tied as the less preferred. Higher endorsement for an online format may be due to the increased privacy, convenience, scheduling flexibility, and location accessibility, particularly when considering nurses’ time pressure at work and difficulty finding the time to participate in person (Wahbeh et al. 2014b; Webster et al. 2019). Our results indicated that nurses who are parents of one child were more likely to endorse an online intervention, potentially because of its scheduling flexibility considering they are individuals with the dual, competing roles of parenting and nursing (Niewboer et al. 2013; Webster et al. 2019; Widyasrini and Lestari 2020). Similar to the positive association found between parents and the endorsement of mindfulness-based training, it was intriguing to note that parents of two or more children did not exhibit a significant, direct relationship with the online format. A possible reason for this may be due to sibling caretaking. As busy, working nurses with more than one child, they may be more likely to already have their adolescent children care for younger siblings, thus resulting in a potential indifference for preferring an online format in regards to time conflicts (Wickle et al. 2018).

Contrarily, age was negatively related to the endorsement of an online intervention; with every year younger, the participants had a higher likelihood of selecting an online format. This may be due to younger adults’ greater affinity for mobile internet usage, especially when born into the digital age (Seifert and Schelling 2015). Also, aging can affect how people behave toward computer technology and thus, the willingness to endorse an online intervention (Mariano et al. 2021). Older nurses may be less proficient with technology and are, therefore, less likely to endorse an online format (Hauk et al. 2018).

Strengths and Limitations

As the main strength, this study is among the first to address the gap in the literature about the individual factors that influence the endorsement of health interventions, particularly for sleep. Research has focused on testing sleep interventions on various cohorts known to experience poor sleep, yet it has not identified individual determinants that potentially affect people’s willingness to seek a sleep intervention and realistically pursue it. As demonstrated by our study, sociodemographic factors, sleep knowledge, and personality may influence one’s endorsement for certain

sleep interventions. Our study accordingly carves a new path for future investigations interested in improving sleep health in nurses or other populations. They may focus on how to effectively implement sleep interventions while considering the influence of individual determinants.

Nonetheless, this study has limitations, and modifications can be implemented in future studies. Although our research followed an exploratory approach to how individual determinants affect the endorsement of sleep interventions, we used a rather crude measure of the endorsement of a sleep intervention by type and delivery. The choices for each distinct type and delivery format could have been limited to one choice or ranked in order of preference to avoid overlap within preferences and identify a clear relationship with the individual determinants.

Additionally, our findings are based on the limited options of sleep interventions that we provided. Future studies could include more options to choose from such as biofeedback, yoga, napping interventions, and adjustment of color temperature from fluorescent lighting at the workplace. In the background survey, we should have also defined the methods for each type of intervention and the specifics of the delivery format. For instance, we could have clarified whether an online delivery format referred to virtual meetings or asynchronous workshops. Making such clarifications in future studies could provide more factual results on how individual determinants influence sleep intervention endorsement. Lastly, our sample was limited to outpatient nurses with similar socioeconomic, demographic, and work-related factors. To assure the findings are representative of the U.S. nursing workforce, a more diverse sample of nurses, especially in terms of sex, race/ethnicity, occupational types and work schedules should be pursued in future research.

CONCLUSIONS

This is one of the pioneering studies in the field of sleep research as it demonstrates that individual determinants for endorsing specific sleep interventions exist and should be further investigated to more effectively implement interventions that improve nurses’ sleep. Previous research has focused on testing the success of sleep interventions, yet little is known about the influence that participants’ determinants and preferences have on such success. Our study thus facilitates future research interested in considering participants’ preferences based on their sociodemographic factors, sleep hygiene knowledge, and personality when designing sleep interventions. Nurses are an important target for sleep interventions because of their increased vulnerability to poor sleep. This population and other healthcare workers constantly experience stressors in and outside of work that hinder their sleep and in turn affect patient care. Hence, poor sleep health in nurses is a public health concern that should be addressed by conducting more interventions that consider



a variety of factors that impact participants' endorsement.

CONFLICTS OF INTEREST/DISCLOSURE

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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