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Noise Exposure and Quality of Life Among Nurses

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Abstract

Background: The purpose of this study was to describe the relationship between noise exposure, selected health conditions, and well-being among nurses.

Methods: A secondary analysis was performed on data obtained from 3,818 U.S. nurses who responded to a survey regarding noise exposure, health conditions, stress, professional quality of life, and workplace support.

Findings: Those who reported high noise exposure reported more health conditions, higher stress and burnout scores, and lower supportive environments. High noise exposure was significantly associated with lower professional quality of life.

Conclusion/Application to Practice: Noise may impact the health and quality of professional life of nurses. Occupational health nurses should advocate for the regular monitoring of nurses' exposure to hazardous noise at work, compare it to OSHA permissible levels, and collaborate with the occupational health team to ensure safe noise levels are maintained. Occupational health nurses should advocate for expanded research on effects of noise on health.

Keywords

noise; nurses; quality of life; stress; burnout; Nurses Million Hearts study

Background

Exposure to hazardous noise is detrimental to human health and adversely affects multiple functions in the body in addition to hearing (Basner & McGuire, 2018). However, most of the attention to reduction and control of noise levels has focused on hearing protection. For example, National Institute for Occupational Safety and Health's (2018) recommended exposure limits for noise have been designed to protect hearing, but they have not set

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Conflict of Interest

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limits to protect other body organs or systems even though noise exposure is associated with negative effects on the cardiovascular system (Babisch, 2014; Vienneau et al., 2015), sleep (Hume, 2010; Munzel et al., 2014), mental health (Seidler et al., 2017), and cognition (World Health Organization, 2015). The strongest evidence to date links noise exposure to increased cardiovascular disease risk (e.g., hypertension, stroke) (van Kempen et al., 2018), sleep disturbances (Basner & McGuire, 2018; Yang et al., 2018), hearing loss, and tinnitus (Sliwinska-Kowalska & Zaborowski, 2017). Although the evidence is strongest for these three outcomes, studies have also found associations between noise exposure and depression (Leijssen et al., 2019) as well as rheumatoid arthritis in adults (Dzhambov & Dimitrova, 2016), and decreased cognition among children (Clark & Paunovic, 2018).

A number of studies have examined the relationship between noise and mental health. A large study in Brazil that interviewed more than 60,000 persons (Oenning et al., 2018) found occupational noise was associated with a higher risk for major depressive disorder in women. In a separate study, Seidler and colleagues (2017) compared risk of depression by source of noise (aircraft, road traffic, and railway) among 77,295 subjects and 578,246 controls, concluding that traffic noise may lead to depression.

Studies of effects of noise are based on noise exposure levels; however, noise itself may only partially explain its negative effects on health. Recent large-scale studies conducted outside the United States have focused on the effects of the individual's perceptions and evaluations of noise, that is, noise annoyance. In a large study (15,000+ subjects), Beutel et al. (2016) found a direct relationship between noise annoyance and prevalence of depression. Hammersen and colleagues (2016) used data obtained from a German national health interview survey among adults (n = 19,294) to measure associations, while controlling for potential covariates, between individual levels of noise annoyance due to noise from various sources in the living environment (road traffic, neighbors and air traffic) and mental health. Odds for impaired mental health more than doubled among those reporting high noise annoyance compared with those not annoyed. In a nationwide British study, Jensen et al. (2019) found that annoyance due to neighbor and traffic noise was associated with both mental and physical symptomatolgy such as pain, sleeping problems, and anxiety.

Although these studies found significant associations between noise (or noise annoyance) and mental health, these cross-sectional studies are inadequate to support causation. Clearly, further study is needed to understand the components of noise annoyance, sources, levels, and duration of noise exposure, and their effects on mental health among both nurses and the public at large. The mechanism of action of noise on the human body is not well understood. Many of the negative effects of noise on health are believed to be related to either stimulation of the human stress response, or secondary to interference with sleep. Noise initiates a cascade of events that includes the release of stress hormones, which in turn, trigger inflammatory and oxidative stress pathways (Hahad et al., 2019).

Health care work environments are recognized as potentially noisy environments. The multiple technologies (many featuring alarms) in health care may produce frequent noisy occurrences and high volumes in the health care environment (Wallis et al., 2019). Paging systems, alarms on devices, telephones, patient beds with multiple electronic parts, ice

machines, bedside monitors, and intravenous pumps are examples of sources of noise in health care settings (Wallis et al., 2019). The noise exposure is estimated to average in the range of 50 to 60 decibels, and reach above 80 decibels in intensive care settings (Litton et al., 2017). In one review of neonatal intensive care units, the authors report a steady increase in ambient patient care area noise from 1960 to 2005, with a 15 decibel increase in daytime noise and an 18 decibel increase in nighttime noise (Konkani & Oakley, 2012).

Noise control is a serious concern for both patients and health care workers. Hospital noise has been repeatedly found to result in negative patient outcomes (e.g., sleep disturbances, anxiety, longer hospital stays, heightened pain) (Garside et al., 2018; Oleksy & Schlesinger, 2019). Positive associations between elevated noise and impaired function of health care workers in the operating room (e.g., ineffective communication, diminished speech intelligibility, poor performance of complex tasks, poor cognitive function and concentration, stress, fatigue, and anxiety) have also been reported (Association of periOperative Registered Nurses, 2014; Hogan & Harvey, 2015; Keller et al., 2016; McNeer et al., 2016). Nurses' sources of noise exposure are not limited to the occupational setting and may include environmental and recreational noise. Consequently, the contribution of occupational noise exposure to nurses' health conditions is difficult to discern. Complicating the relationship between noise exposure and its effects on human health, smoking is known to exacerbate the effects of noise exposure on hearing loss (Li et al., 2020).

Although noise in the health care environment can be harmful to patient recovery and safety, little is known about how noise affects the health of nurses. The purpose of this study was to examine the relationship between noise exposure among nurses, their health conditions, and professional quality of life using an existing data set.

Methods

This was a secondary data analysis of a national survey of nurses by Melnyk and colleagues (2018) which included measures of (a) self-reported noise exposure information; (b) depression (PHQ-2: Patient Health Questionnaire-2) (Kroenke et al., 2010); (c) anxiety (GAD-2: General Anxiety Disorder-2) (Plummer et al., 2016); (d) stress (PSS-4: Perceived Stress Scale-4 item) (Cohen et al., 1983); (e) professional quality of life (ProQOL) (Stamm, 2010); (f) self-reported physical health and mental health; (g) perceived workplace wellness support; and (h) medical errors made in the prior 5 years. Invitations to participate in the survey were disseminated to members of 10 professional nursing organizations and staff at 20 large and small hospitals across the United States. The study protocol was reviewed by the University of Michigan Institutional Review Board and determined to be exempt.

Demographic data included age, gender (male, female), race/ethnicity (non-Hispanic White, non-Hispanic Black, Native American/Alaska Native, Asian/Pacific Islander, Hispanic, multiracial/other), education (AD/diploma, BSN, Master's, doctorate), marital status (married/in a relationship, never married/divorced/widowed), history of chronic illness (present/not present), work-related data including primary role in nursing (clinical, academic, administrative, retired/other), and hours of work per day/shift (<8, 8, 9–10, 11–

12, >12). We queried smoking history (current/past), including type of smoking device (including e-cigarette use), and setting (indoors at home and at work).

Self-reported noise exposure was assessed by asking the worker, “How many hours per week would you say you are exposed to high noise? (1) 0 hours, (2) 1–5 hours, (3) 6–10 hours, or (4) greater than 10 hours?” For this question, “high noise” was defined as having to raise one’s voice to be heard by someone who is three feet away (Singh, 2019). This definition of noise is also used in the National Health and Nutrition Examination Survey (National Center for Health Statistics, 2020). in the analysis, exposure to high noise measured in hours was dichotomized to ≤5 hours/week or ≥ 6 hours per week.

The Patient Health Questionnaire-2 (PHQ-2) (Kroenke et al., 2010), a valid and reliable measure, was used to assess depressive symptoms. The questionnaire consists of two items on a 4-point Likert-type scale which assesses frequency of depressed mood and anhedonia over the past 2 weeks. The two tems were each scored as 0 (“*not at all*”) to 3 (“*nearly every day*”) and summed; a PHQ-2 score of ≥3 was indicative of major depression. The Cronbach’s alpha in this sample was .81.

Anxiety was measured using the Generalized Anxiety Disorder Questionnaire-2 (GAD-2), a brief, psychometrically valid tool (Plummer et al., 2016). The GAD-2 consists of two items on a 4-point Likert-type scale assessing symptoms of generalized anxiety disorder over the past 2 weeks. In this analysis, the sum of two selected questions (frequency of feeling nervous, anxious or on edge, Not being able to stop or control worrying) was used. Scores for each item ranged from 0 to 3 (0 = *not at all* to 3 = *nearly every day*) and were summed. A GAD-2 score of ≥3 was indicative of probable anxiety disorder. Cronbach’s alpha in this sample was .79.

The Perceived Stress Scale (PSS-4), a valid and reliable four item instrument, was used to measure the degree to which situations in one’s life over the past month were appraised as stressful (Cohen & Williamston, 1988). A sample item from this scale is, “In the last month, how often have you felt that you were unable to control the important things in your life?” Items were rated on a 5-point Likert-type scale (0 = *never* to 4 = *very often*). In this study, the PSS-4 score was calculated by summing the four items, with higher scores indicating higher stress; the Cronbach’s alpha improved from 0.63 to 0.85 (for all three items) after excluding the question “How often have you felt that things were going your way?”

Professional quality of life was measured by the ProQOL instrument, which measures compassion satisfaction, burnout, and compassion fatigue (Stamm, 2002). Compassion satisfaction was defined as the pleasure one derives from being able to do one’s work well. Compassion fatigue was conceptualized as work-related, secondary exposure to extremely stressful events Osofsky et al., 2008). In this study, the Cronbach’s alphas were adequate for each item: .87 (compassion satisfaction), .72 (burnout), and .80 (compassion fatigue). We included four questions from the ProQOL instrument: “I feel worn out because of my work,” “I feel trapped by my job,” “I am not engaged with my patients today as I used to be,” and “I believe I can make a difference through my work.” The ProQOL score was calculated by summing the three items from this instrument.

Self-reported physical health and mental health were assessed by two items on the survey. Participants were asked to rate their current physical health and current mental health using scales of 0 (*very unhealthy*) to 10 (*extremely healthy*). Workplace wellness support was assessed by four questions asking about perceived support of the work environment to one's personal wellness (e.g., "How supportive is your work environment of personal wellness?"); stressful work environment, importance of wellness in nursing curricula, and ability to engage with daily work. The score for each item on a 5-point Likert-type scale (0 = *not at all* to 4 = *very much so*) was used in this analysis. Higher scores indicated greater perceived workplace wellness support.

Statistical Analysis

Descriptive statistics were used to summarize sample characteristics. Bivariate tests (*t* test and chi-square statistic) were used to examine associations of high noise exposure with sample characteristics, self-reported depression, anxiety, stress, and professional quality of life (ProQOL). Between-group differences were determined based on effect sizes (i.e., Cohen's *D*; odds ratio [OR]) and statistical significance (*p* value) of the bivariate analysis.

Linear regression modeling was used to examine the unadjusted and adjusted effects of high noise exposure on ProQOL. In unadjusted analysis, each independent variable was included in a linear regression model as a single predictor of ProQOL. In the adjusted analysis, high noise exposure and covariates (age, primary role, education, hours of work day/shift, history of depression, history of back pain or musculoskeletal problems, history of arthritis, and smoke indoor at home/work) were included simultaneously as predictors of ProQOL in the model. The covariates were chosen because they were significantly associated with high noise exposure in the bivariate analysis. (Other variables had small associations with noise exposure or were item-level variables.) All tests were two-sided with a significance level of .05. SAS 9.4 (SAS® Institute, Cary, North Carolina) was used for all the analyses.

Results

A total of 3,818 nurses volunteered to participate in the survey. The total size of the sampling frame was not known; therefore, a response rate could not be calculated. Table 1 shows the sample's average age was 49 years, and 94% were female. Nearly 90% were White, and about 8% were minorities (i.e., Black, Hispanic, American Indian, Asian, Multi-racial). Nearly one-third (32%) reported having a master's degree, and over one-quarter (29%) had a bachelor's degree. One in five (23%) held a doctorate. Nurses in clinical practice were the most represented (46%), while academics (22%) and administrators (10%) and other and retired nurses (19%) also participated. High noise exposure was reported among 7% of participants. Self-reported health conditions included hypertension (25%), heart disease (3%), depression (23.4%), and anxiety (19.1%). Only a small distribution of the nurses were current smokers (3.3%), 2.6% smoked inside their home only, 1.3% smoked indoor at work only, and 0.1% smoked indoor at both home and work.

Younger nurses ($p > .001$) and nurses in clinical practice ($p < .001$) were more likely to report high noise exposure, while nurses with higher education were less likely to report

exposures to high noise. Nurses working longer shifts, reporting a history of depression, back/musculoskeletal pain, or arthritis were more likely to have high noise exposures. We also explored the relationship between smoking and noise exposure, as smoking is synergistic with noise in contributing to hearing loss. Compared with those who did not smoke indoor at home/work, a respondent who reported smoking indoor at home only was twice as likely to have high noise exposure and nurses who reported smoking indoors at work only were four to five times as likely to have high noise exposure. Although those reported smoking indoor at both home and work ($n = 3$) appeared to have lower odds of having high noise exposure, the estimate was not accurate due to the small sample size. (Data not shown, but available in Supplementary Material.)

We explored in Table 2 the bivariate associations between high noise exposure and selected health outcomes (e.g., self-reported physical health, mental health, depression, anxiety, stress, and professional quality of life). Compared with participants who had low noise exposure, nurses reporting high noise exposure had lower Professional Quality of Life (ProQOL) total scores, higher burnout scores, and were more likely to report that employment was stressful (all with medium-size effects). Respondents with higher noise exposure were also slightly more likely to report feeling trapped by their job (a measure of burnout), less engaged with work, and having less support at work (all with small effect sizes). Respondents with higher noise exposure also reported higher Generalized Anxiety Disorder and Perceived Stress scale scores, and higher selected Generalized Anxiety Disorder 2 items (i.e., nervous/anxious/on edge, not able to stop/control worrying, unable to control important things, unable to handle problems, difficulties piling too high to overcome, trapped by job, and not as engaged as used to be).

Respondents with lower noise exposure were more likely to report a supportive employment environment (medium effect size). They were also more likely to report better physical and mental health, and were slightly more likely to view wellness in nursing curricula as important and believed that they could engage daily with work.

Table 3 shows the unadjusted and adjusted linear regression analyses of the effects of high noise exposure on professional quality of life. High noise exposure was significantly associated with lower professional quality of life (coefficient = −1.78, standard error [SE] = 0.20, $p < .001$) in the unadjusted analysis. The negative association between noise exposure and professional quality of life was sustained (coefficient = 1.32, SE = 0.19, $p < .001$) after adjusting for other covariates in the model. Other variables that were significantly associated with higher professional quality of life in the adjusted analyses included older age, retired, shorter hours of workday/shift, and having no history of depression or backpain/musculoskeletal problems.

Discussion

This study examined a subset of data from a national survey of nurses by Melnyk and colleagues (2018) and compared characteristics of nurses who were exposed to high and low noise levels, and examined the relationship between noise, health conditions, and professional quality of life. Participants who were exposed to high noise levels were

more likely to report illness (i.e., hypertension, heart disease, depression, anxiety), higher workplace stress, lower supportive work environments, and higher burnout scores. They were also more likely to be younger, have less education, work in the clinical setting, and work more hours per day.

The differential exposure of younger nurses to noise is of interest. In the experience of the authors, younger nurses may be more likely to work in higher noise clinical settings than their counterparts working in administrative or academic positions. Furthermore, the contribution of occupational noise to nurses' health is of interest. It can be argued that environmental and recreational noise exposures are responsible for effects on health than those in the nurses' workplace. However, the fact that nurses working longer shifts were more likely to report high noise exposures suggests that workplace noise exposures may be a significant factor. Future studies should assess the sources and duration of occupational versus non-occupational noise exposure among nurses.

The nurses' reports of hypertension and heart disease with greater noise exposure are entirely consistent with the literature, with numerous studies from around the world providing strong evidence of the effect. In fact, in the United States, it has been estimated that a reduction of a modest 5 decibels in environmental noise levels (within the range of 45 to 75 decibels) would reduce the prevalence of hypertension by 1.4% and coronary heart disease by 1.8%, resulting in an annual economic benefit of $3.9 billion (Swinburn et al., 2015).

Nurses reporting a history of depression, back pain/musculoskeletal problems, or arthritis were also more likely to report high noise exposure. These relationships between health problems and high noise exposures were not unexpected based on the numerous research studies summarized in the American Academy of Nursing's Policy Brief, *Reduce Noise: Improve the Nation's Health* (Lusk et al., 2017) which delineated the contribution of noise to many health problems. While studies of noise effects have not addressed musculoskeletal problems or arthritis, many have assessed the effect of noise on depression and mental health. As previously reported, the associations have been between both actual noise measurements, as well as measurements of levels of *annoyance* due to noise. It is not known to what extent the deleterious effects are due to the stress response to the noise itself or the annoyance it creates, and this study did not measure noise annoyance. Since no measure of actual noise exposures was possible in this study, the self-reported level of noise exposure may have been influenced by the individual's level of annoyance from the noise. Although a number of studies (Beutel et al., 2016; Hammersen et al., 2016; Jensen et al., 2019; Oenning et al.,2018; Seidler et al., 2017) found significant associations between noise annoyance and mental health, these cross-sectional studies are inadequate to support causation. Further study is needed to understand the components of noise annoyance, sources, levels, and duration of noise exposure, and their effects on mental health among both nurses and the public at large.

Although nurses in this study with self-reported higher noise exposure were more likely to have neuro-muscular/back problems, no previous studies were found with similar findings. Given the multiple possible contributors to the reports of neuro-muscular/back problems,

the relationship between noise and this phenomenon should be examined in future studies. However, given the documented negative effects of noise annoyance, it is possible that noise could exacerbate these physical problems.

There was an unexpected finding in this study: respondents who smoked inside daily were twice as likely to have high noise exposure as those who never smoked. Nurses who reported smoking indoors at work were four times as likely to have reported high noise exposure. Possible explanations for these findings are that these participants may be less oriented to healthy behavior (Masood et al., 2015). They may be less concerned about the effect of smoking on health, and/or unaware of the negative effects of exposure to noise, thereby not trying to avoid it when possible. Alternatively, stress from high noise may increase the need to escape from the noise, creating a need or desire to smoke as a stress reducer. This finding is particularly significant in that smoking is known to exacerbate the negative effects of noise on hearing (Mehrparvar et al., 2015).

Even though the large sample size of this study was a strength, the conclusions to be drawn from this study are limited by several factors: (a) Data were provided by a convenience sample of participants who may have been differentially motivated to participate by personal concerns about noise and working conditions; (b) This convenience sample underrepresented minority nurses; (c) As a cross-sectional study, causal inferences cannot be made; in fact, it is possible that job-related stress (e.g., patient care, longer shifts) may explain health conditions and lower professional quality of life); (d) The survey item on noise was not originally designed to definitively measure quantity of noise exposure, making it necessary to dichotomize the noise exposure question responses into high or low noise exposure; thus, limiting its value; (e) The survey item on noise did not obtain the source of noise exposure, making it impossible to isolate occupational exposures from environmental and recreational sources; and (f) The survey obtained dichotomized (yes/no) responses for only a short list of health problems; therefore, determining the relationship of nurses' noise exposure to health could be assessed for only a few of the conditions known to be affected by noise, excluding many other health conditions known to be affected by noise (e.g., obesity, sleep problems, job performance, low birth weight infants).

Given the extensive research data that support the associations between noise exposure and multiple health conditions, and to assure the health of millions of nurses, further study of the prevalence and levels of noise exposure among nurses is needed. Inclusion of measurement of noise exposure would be a valuable addition to future studies. A more comprehensive examination of the relationship between sources and durations of nurses' exposures to noise, and their health conditions would aid in promoting the health of this large and essential worker group.

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Implications for Practice

Noise may impact the health and quality of professional life of nurses. Occupational health nurses who work in health care settings should advocate for the regular monitoring of nurses' and other health care workers' exposure to hazardous noise at work, compare it to OSHA permissible levels, and collaborate with the occupational health team to ensure safe noise levels are maintained. This may involve educating workers, supervisors and leadership, setting up noise monitoring and possibly hearing surveillance programs and exploring the best options for reducing noise if elevated noise levels are found. Occupational health nurses should advocate for expanded research on effects of noise on health, and nurses' health in particular.

Table 1.

Relationship Between Demographics, Health Behaviors, and Health Conditions by Level of Noise Exposure ($N = 3818$)

Participant Demographics and Health Coniditions	All		Noise exposure				Odds ratio of having high exposure	*p* value
			Low (≤5 hr/week)		High (≥6 hr/week)			
	M	*SD*	*M*	*SD*	*S*	*MD*		
Age	49.6	13.9	49.8	13.9	46.8	13.4	0.98	<.001
	n	Column%	*n*	Row%	*n*	Row%	Odds ratio of having high exposure	*p* value
Gender								.72
Man	197	5.2	180	91.4	17	8.6	Reference	
Woman	3,601	94.3	3,345	92.9	256	7.1	0.81	
			—	—	—	—		
Race/ethnicity								
Non-Hispanic White	3,412	89.4	3,167	92.8	245	7.2	Reference	.18
Non-Hispanic Black	124	3.2	119	96.0	5	4.0	0.54	
American Indian/Alaskan Native	81	2.1	14	77.8	4	22.2	3.69	
Asian/Pacific Islander	18	0.5	79	94.0	5	6.0	0.82	
Hispanic	84	2.2	75	92.6	6	7.4	1.03	
Multiracial/Other	81	2.1	74	91.4	7	8.6	1.22	
Marital/relationship status								.11
Married/in a relationship	2,963	77.6	2,761	93.2	202	6.8	Reference	
Never married/divorced/widowed	840	22.0	769	91.5	71	8.5	1.26	
Primary role								<.001
Practice	1,790	46.9	1,624	90.7	166	9.3	Reference	
Academic	847	22.2	816	96.3	31	3.7	0.37	
Administrative	414	10.8	380	91.8	34	8.2	0.88	
Other/retired	748	19.6	706	94.4	42	5.6	0.58	
Degree								<.001
ADA/diploma	288	7.5	256	88.9	32	11.1	Reference	
BSN	1,133	29.7	1,027	90.6	106	9.4	0.83	

Participant Demographics and Health Coniditions	All		Noise exposure				Odds ratio of having high exposure	*p* value
			Low (≤5 hr/week)		High (≥6 hr/week)			
	M	*SD*	*M*	*SD*	*S*	*MD*		
Master	1,250	32.7	1,175	94.0	75	6.0	0.51	
Doctor	914	23.9	873	95.5	41	4.5	0.38	
Other	216	5.7	198	91.7	18	8.3	0.73	
Hours of work day/shift								<.001
<8 hours	311	8.1	299	96.1	12	3.9	Reference	
8 hours	821	21.5	781	95.1	40	4.9	1.28	
9–10 hours	1,404	36.8	1,316	93.7	88	6.3	1.66	
11–12 hours	415	10.9	369	88.9	46	11.1	3.11	
>12 hours	775	20.3	690	89.0	85	11.0	3.07	
Health conditions								.846
Hypertension								
Yes	974	25.5	903	92.7	71	7.3	1.03	
No	2,844	74.5	2,641	92.9	202	7.1	Reference	
Heart disease								.150
Yes	113	3.0	101	89.4	12	10.6	1.57	
No	3,705	97.0	3,443	93.0	261	7.0	Reference	
Pre-diabetes								.969
Yes	338	8.9	314	92.9	24	7.1	0.99	
No	3,480	91.1	3,230	92.8	249	7.2	Reference	
Type I diabetes								.958
Yes	27	0.7	25	92.6	2	7.4	1.04	
No	3,791	99.3	3,519	92.8	271	7.2	Reference	
Type II diabetes								.656
Yes	175	4.6	161	92.0	14	8.0	1.14	
No	3,643	95.4	3,383	92.9	259	7.1	Reference	
High cholesterol								.989
Yes	1,036	27.1	962	92.9	74	7.1	1.00	

Participant Demographics and Health Coniditions	All		Noise exposure				Odds ratio of having high exposure	*p* value
			Low (≤5 hr/week)		High (≥6 hr/week)			
	M	*SD*	*M*	*SD*	*S*	*MD*		
No	2,782	72.9	2,582	92.8	199	7.2	Reference	
Depression								.007
Yes	893	23.4	811	90.8	82	9.2	1.45	
No	2,925	76.6	2,733	93.5	191	6.5	Reference	
Anxiety								.161
Yes	730	19.1	669	91.6	61	8.4	1.24	
No	3,088	80.9	2,875	93.1	212	6.9	Reference	
Cancer								.860
Yes	347	9.1	323	93.1	24	6.9	0.96	
No	3,471	90.9	3,221	92.8	249	7.2	Reference	
Back pain/musculoskeletal problems								.010
Yes	1,187	31.1	1,083	91.2	104	8.8	1.40	
No	2,631	68.9	2,461	93.6	169	6.4	Reference	
Arthritis								.005
Yes	841	22.0	762	90.6	79	9.4	1.49	
No	2,977	78.0	2,782	93.5	194	6.5	Reference	
Current smoker								.077
Yes	125	3.3	111	88.8	14	11.2	1.67	
No	3,692	96.7	3,433	93.0	259	7.0	Reference	
Smoke indoor at home/work								<.001
Home only	97	2.6	83	85.6	14	14.4	2.38	
Work only	49	1.3	37	75.5	12	24.5	4.58	
Both home and work	3	0.1	3	100.0	0	0.0	<0.001	
Neither home nor work	3,628	96.1	3,388	93.4	240	6.6	Reference	

Note. Cutoffs of effect size measures: odds ratio (OR) – 1.68 (or 0.60 if OR < 1, small), 3.47 (or 0.29 if OR<1, medium), and 6.71 (or 0.15 if OR < 1, large). *SD* standard deviation.

Table 2.

Relationship of Noise Exposure and Current Physical and Mental Health (n = 3818)

	Noise exposure					
	Low (≤5 hr/week)		High (≥6 hr/week)			
Variable (score range)	***M***	***SD***	***M***	***SD***	**Cohen's *D***	***p* value**
Self-rated physical health (0–10)	7.3	1.7	6.7	1.8	0.35	<.001
Self-rated mental health (0–10)	8.0	1.7	7.2	2.1	0.46	<.001
PHQ2 total score (0–6)[a]	0.5	1.0	0.8	1.3	0.29	<.001
GAD2 total score (0–6)[b]	0.9	1.2	1.3	1.5	0.33	<.001
PSS4 total score, (0–16)[c]	3.7	2.7	5.0	3.2	0.47	<.001
ProQOL total score (4–20)	15.3	3.1	13.5	3.6	0.57	<.001
PROQOL Q1 Feel worn out by work (1–5)[d]	2.8	1.1	3.4	1.1	0.55	<.001
PROQOL Q2 Feel trapped by job (1–5)[d]	2.0	1.1	2.5	1.3	0.45	<.001
PROQOL Q3 Not as engaged as used to be (1–5)[d]	2.0	1.0	2.5	1.2	0.49	<.001
PROQOL Q4 Believe can make a difference (1–5)[d]	4.0	1.1	3.8	1.1	0.18	.001
Workplace wellness: Supportive (1–5)	3.5	1.2	3.0	1.3	0.41	<.001
Workplace wellness: Stressful (1–5)	3.5	1.2	4.1	1.1	0.50	<.001
Workplace wellness: Important to embed wellness in nursing curricula (1–5)	4.3	1.0	4.1	1.2	0.20	.002
Workplace wellness: Believe you can engage daily (1–5)	3.9	1.0	3.5	1.1	0.40	<.001

Note. SD = standard deviation; PHQ2 = Patient Health Questionnaire-2; GAD2 = General Anxiety Disorder-2; PSS4= Perceived Stress Scale-4 item; PROQOL = Professional Quality of Life.

[a]Patient Health Questionnaire-2 (PHQ-2) (Kroenke et al., 2010).

[b]General Anxiety Disorder-2 (GAD-2) (Plummer et al., 2016).

[c]Perceived Stress Scale-4 item (PSS-4) (Cohen et al., 1983).

[d]Professional Quality of Life (ProQOL) (Stamm, 2010).

Table 3.

Unadjusted and Adjusted Linear Regression Analyses of the Effects of High Noise Exposure on Professional Quality of Life (ProQOL) (*N* = 3818)

	Unadjusted			Adjusted		
Independent variables	**Coefficient (*SE*)**	***P***	**Overall *p***	**Coefficient (*SE*)**	***P***	**Overall *p***
Exposure to high noise			<.001			<.001
High (≥6 hr/wk)	−1.78 (0.20)	<.001		−1.32 (0.19)	<.001	
Low (≤5 hr/wk)	reference			reference		
Age (years)	0.05 (0.00)	<.001	<.001	0.03 (0.01)	<.001	<.001
Primary role						.003
Practice	reference		<.001	reference		
Academia	0.78 (0.13)	<.001		0.03 (0.16)	.788	
Administrative	−0.06 (0.17)	.710		−0.50 (0.17)	.003	
Other/retired	1.04 (0.14)	<.0011		0.19 (0.15)	.196	
Education			<.001			.225
ADA/diploma	reference			reference		
BSN	0.28 (0.21)	.189		0.25 (0.20)	.082	
Master	0.95 (0.21)	<.001		0.34 (0.21)	.428	
Doctor	1.11 (0.21)	<.001		0.18 (0.23)	.048	
Other	1.05 (0.29)	<.001		0.53 (0.28)	.188	
Hours of work day/shift						<.001
<8 hours	reference		<.001	reference		
8 hours	−1.31 (0.21)	<.001		−0.83 (0.21)	<.001	
9–10 hours	−1.80 (0.20)	<.001		−1.36 (0.19)	<.001	
11–12 hours	−2.16 (0.23)	<.001		−1.54 (0.23)	<.001	
>12 hours	−2.70 (0.21)	<.001		−1.80 (0.22)	<.001	
History of depression						<.001
Yes	−1.44 (0.12)	<.001	<.001	−1.18 (0.12)	<.001	
No	reference			reference		
History of back pain/musculoskeletal problems						<.001

Independent variables	Unadjusted			Adjusted		
	Coefficient (*SE*)	*P*	Overall *p*	Coefficient (*SE*)	*P*	Overall *p*
Yes	−0.62 (0.11)	<.001	<.001	−0.53 (0.11)	<.001	
No	reference			reference		
History of arthritis			.831			.118
Yes	0.03 (0.13)	.831		−0.21 (0.13)	.118	
No	reference			reference		
Smoke inside home/work			.002			.096
Home only	−0.75 (0.33)	.024		−0.49 (0.31)	.117	
Work only	−1.45 (0.45)	.002		−0.87 (0.43)	.045	
Both home and work	2.30 (2.25)	.894		0.10 (2.12)	.963	
Neither home nor work	reference			reference		

Note. ProQOL = Professional Quality of Life; *SE* = standard error.