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Depression and Anxiety: Investigating the Impacts of Scheduling on the Mental Health of Healthcare Workers During the COVID-19 Pandemic

Christofer Gonzaga
cgonzag@g.clemson.edu

DEPRESSION AND ANXIETY: INVESTIGATING THE IMPACTS OF SCHEDULING ON THE MENTAL HEALTH OF HEALTHCARE WORKERS DURING THE COVID-19 PANDEMIC

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Christofer Andres Gonzaga
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Accepted by:
Dr. David M. Neyens, Committee Chair
Dr. Emily Tucker
Dr. Mariah Magagnotti

ABSTRACT

Depression is a growing problem in the United States and has ballooned into a globally recognized mental health issue that affects shift workers in various fields (Lee et al., 2017). Rates of depression and anxiety have been shown to be increasing and the COVID-19 pandemic amplified the prevalence of depression and anxiety. In the United States, the prevalence of depression symptoms was more than 3-fold higher during COVID-19 compared to before the pandemic (Ettman et al., 2020). The delivery of healthcare services is an ongoing and dynamic process, requiring clinicians to work in various shifts to ensure the delivery of effective and continuous patient care. As a result of this scheduling approach, it is necessary to explore the impact of shift work on both worker outcomes and mental health. This persistent strain on mental health stemming from the demands of shift work amplifies the risk of burnout among healthcare workers (Cheng et al., 2022). The objective of this thesis is to investigate the association between work-related, and demographic variables with self-reported depression severity and anxiety frequency among healthcare workers using the 2021 National Health Interview Survey (NHIS) data. The NHIS is conducted annually by the National Center for Health Statistics, this acts as a pivotal tool in assessing a wide array of health-related topics. To address this objective, logistic regression models were used to analyze relationships between binary outcome variables and predictor variables. Data analysis was performed using R. Healthcare workers who reported engaging in shift work during day, evening and rotating shifts were found to be more likely to report depression. Healthcare workers who reported working day, night, or rotating shifts were significantly less likely to report having frequent (daily or weekly) anxiety when compared to all other shifts. Healthcare workers are not immune from the current mental health crisis (Vizheh et al., 2020) and work needs to be done to support them, especially as shift work is foundational to providing high quality care to patients. Recognizing and addressing these challenges is essential to ensuring the wellbeing of shift workers and sustaining a resilient workforce in the future.

DEDICATION

This thesis is dedicated to my parents, Carol, and Andres Gonzaga. Throughout my academic journey, their encouragement has been a guiding light for me and their belief in my abilities has not only humbled me but also empowered me to persevere in the face of challenges. As I reflect on the countless sacrifices they have made to push me to reach my dreams, I am filled with an indescribable sense of gratitude. To my dear parents, whose love knows no bounds, I extend my deepest thanks. Your unwavering faith in me has been the driving force behind my achievements and every milestone that I have reached. This thesis is a tribute to your love, guidance, and unwavering belief in me.

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CHAPTER ONE:

INTRODUCTION

Depression & Its Impact

Depression is a growing problem in the United States and has ballooned into a globally recognized mental health issue that affects shift workers in various fields (A. Lee et al., 2017). Rates of depression and anxiety have been shown to be increasing and the COVID-19 pandemic only amplified the prevalence of depression and anxiety. That is, rates of both depression and anxiety during the pandemic jumped from pre-pandemic levels of 7.1% for adults and 13.3% for children to 19.1% and 31.8%, respectively (Kalin, 2020). Depression and anxiety have implications for all aspects of an individual's life but can substantially impact their ability to work and the quality of their work. It has been shown that depression impacts the quality of work in various fields by decreasing worker's task focus and productivity (Wang et al., 2004). Additionally, it has been shown that worker absenteeism and poorer general health outcomes are prevalent in employees that suffer from depression (Lerner et al., 2010). Depression has also been linked to individuals having lower assessments of their self-identity and life events (Bishop & Gagne, 2018). It has been shown that anxiety and depression have their own symptomology, however individuals suffering from one or both have a difficult time making decisions (Bishop & Gagne, 2018). Additionally, both anxiety and depression are associated with altered estimates of future event likelihood and a tendency to estimate negative outcomes. Anxiety has been shown to be responsible for professional inefficacy, particularly in a healthcare environment (Golonka et al., 2019). Depression can be

responsible for “dimensions” of exhaustion, a sense of disillusion, and neuroticism. Depression has also been shown to lead to an increased risk for alcohol addiction, and social abandonment, or disapproval from a group. Both addiction and social abandonment have been identified as a precursor to increased likelihood of unemployment (Ganesan et al., 2021).

COVID-19 & Mental Health

The COVID-19 pandemic impacted the mental health of many individuals with the general stress of lockdowns, general health risks and initial unknowns. That is, during COVID-19 the prevalence of any form of depression was reported to be 20%, anxiety was reported at 35%, and higher levels of stress than normal were found in 53% of individuals globally (Lakhan et al., 2020). Another study estimated that the global pooled prevalence of depression during the COVID-19 pandemic was roughly 7 times higher than in 2017, suggesting that COVID-19 had a significant impact on mental health (Bueno-Notivol et al., 2021). In the United States, the prevalence of depression symptoms was more than 3-fold higher during COVID-19 compared to before the pandemic (Ettman et al., 2020). Specifically, individuals with lower economic or social resources, as well as greater exposure to stressors, such as job loss or being a frontline worker reported a greater burden of depression symptoms (Ettman et al., 2020). COVID-19 also changed work structures, work tasks, and work environments. COVID-19 forced most of the global population to self-isolate from family or friends and loneliness was reported to be at an all-time high during the pandemic with 43% of the population self-reporting that they were lonely (Killgore et al., 2020). This contributed to higher levels of

depression and a rise in suicidal thoughts (Killgore et al., 2020). Social isolation, which is defined as physical separation, differs from loneliness which is defined as a feeling of disconnectedness (Pancani et al., 2021). While social isolation differs from loneliness the general symptomology is the same. Loneliness during the pandemic was found to be the main risk factor for anxiety and depression (Palgi et al., 2020). The only group that was shown to be less at risk for both anxiety and/or depression was the elderly population (Palgi et al., 2020) and the highest risk was reported in the young adult population (Daly et al., 2021).

Healthcare workers were among the most likely occupations to become ill, with approximately 39% of doctors reporting being sick once during the COVID-19 pandemic with the roles providing direct healthcare for those with COVID-19 (Khorasanee et al., 2021). Healthcare workers, as a result, were required to isolate themselves from their family in some instances due to COVID symptoms or to prevent potential exposure to their families. This may have involved sleeping in separate bedrooms or living in a separate areas entirely. This self-inflicted isolation strategy may have reduced the spread of COVID-19, but the separation and isolation may have contributed to psychological distress for healthcare workers during this time (Galbraith et al., 2021). In addition to the isolation that healthcare workers experienced, they also experienced traumas associated with COVID-19 and providing care for COVID-19 patients and their families, stress and worry about their own health, and work scheduling and staffing issues that contributed to more anxiety associated with their healthcare work (Galbraith et al., 2021).

Concerns in Healthcare

As a result of COVID-19 inflicted self-isolation and loneliness, concerns in the healthcare field have continued to grow surrounding worker shortages. It has been shown that the impact of COVID-19 on worker shortages will continue to have substantial effects as estimates show 23 out of 50 states will have a failing physician to patient ratio by 2030 (Zhang et al., 2020). Prior to the COVID-19 pandemic the healthcare network was strained for workers, with many networks containing understaffed or less than adequate staffed facilities (Glette et al., 2017). In April of 2020, near the beginning of the COVID-19 pandemic, employment in the healthcare sector decreased by 9.3% relative to the previous month (Wilensky, 2022). In November of 2021 healthcare employment levels continued to remain at a decreased level with roughly 2.7% less workers when compared to February 2020 (Wilensky, 2022). While these worker shortages in the healthcare field continue to effect the healthcare workers themselves, there may also be impacts on patient care including longer wait times (Propper et al., 2020), missed or delayed care (Metcalf et al., 2018), and potentially patient safety issues (Glette et al., 2017). Healthcare workers generally work in high stress, long hours and demanding jobs and the COVID-19 pandemic created additional stress (Teo et al., 2021), long hours (Jokwiro et al., 2022), and increased job demands (Huhtala et al., 2021). The higher demands on existing staff, related to more frequent shifts, longer shifts or a combination of all of these factors may have resulted in increased risk for patient safety implications and impacts on the quality of care (Huhtala et al., 2021).

The mental health implications of the COVID-19 pandemic have taken a toll on healthcare workers globally. Studies conducted across various regions highlight the impact on the well-being of these professionals. In India, healthcare workers reported elevated levels of stress, depressive symptoms, and anxiety at rates of 3.7%, 11.4%, and 17.7%, respectively (Wilson et al., 2020). These psychological factors have been identified as contributors to healthcare worker burnout over time (Wilson et al., 2020). Similarly, self-reported data from healthcare professionals during the pandemic revealed concerning figures. In a study, 23% of healthcare professionals acknowledged experiencing anxiety, while 39% reported moderate or high levels of self-diagnosed depression (Motahedi, 2021). A comprehensive umbrella review of meta-analyses further reinforced these findings, concluding that the prevalence of anxiety and depression was notably high among healthcare workers during the COVID-19 pandemic (Sahebi et al., 2021). A focused analysis of healthcare workers in Japan underscored the widespread impact on mental health, with 10% developing moderate to severe anxiety disorders, and 27.9% experiencing symptoms of depression (Awano, 2020). These results demonstrate the profound mental health challenges faced by healthcare workers, adding an additional layer of complexity to their already demanding roles in the face of the pandemic.

Shift Work

The delivery of healthcare services is an ongoing and dynamic process that requires the clinicians to work in various shifts to ensure the delivery of effective and continuous patient care. As a result of this scheduling approach, it is necessary to explore the impact of shift work on both worker outcomes and mental health. Shift work, with its

inherent variability in work hours and sleep patterns, has been shown to have a considerable impacts on physical and mental health for individuals working in healthcare (d'Ettorre et al., 2020). Shift duration, night shift frequency and schedule predictability were all shown to influence off-shift-well-being for healthcare workers (Barnes-Farrell et al., 2008). For example, longer shift durations and more frequent night shifts were associated with a lower overall well-being, whereas schedule predictability was shown to have a positive influence on well-being (Barnes-Farrell et al., 2008).

Shift Work Disorder (SWD) is another challenge faced by healthcare shift workers which has negative effects on the well-being of these individuals. SWD is a persistent or reoccurring pattern of sleep disturbance including insomnia or excessive sleepiness directly associated with a work schedule that overlaps with typical sleep times (Brown et al., 2020). Not only has it been associated with multiple negative physical and mental health effects, but also workplace consequences such as accidents or mental errors (Brown et al., 2020). The literature suggests that the determinants of SWD contribute to the challenges faced by healthcare professionals engaged in shift work. A high number of nights worked per year, long night shifts, frequent missing of nap opportunities and quick returns to work such as back-to-back night shifts, were all found to be determinants of SWD (d'Ettorre et al., 2018).

The disruptions to circadian rhythms and irregular sleep patterns associated with shift work can lead to sleepiness during waking hours and difficulty falling asleep when off from work, further exacerbating the strain on the well-being of healthcare workers. Sleepiness was found to be more prevalent in healthcare shift workers, and 29.8% of

these workers report taking between 31 and 60 minutes to fall asleep upon trying to do so (Alshahrani et al., 2017). Approximately 24% of these workers take more than an hour to fall asleep and 7.4% use medication to fall asleep which has been shown to be a problem among shift workers (Alshahrani et al., 2017). For healthcare professionals navigating shift work, maintaining a balanced work-life dynamic becomes an increasingly challenging due to irregular schedules and unpredictable hours (Williams, 2008). The intersection of patient care demands, and personal life reveals the need to explore the implications of shift work on work-life balance, recognizing the negative impacts it possesses on both mental and physical health. Examining the broader context of work-life dynamics, it becomes evident that the implementation of schedule predictability via self-rostering not only enhances overall shift work and work-life balance but also addresses the negative impacts associated with work-life conflict, recognizing its potential harm to both mental and physical health (Albertsen et al., 2014). Notably, Albertson et al., (2014) suggests that improved schedule predictability among shift workers plays a pivotal role in bolstering mental health, alleviating stress arising from sleep requirements, family obligations, and job demands.

The cognitive effects of shift work on healthcare professionals are also a critical aspect to consider, as irregular schedules and disrupted sleep patterns can significantly impact cognitive performance. The literature shows that shift work fatigue induced cognitive performance decline at the end of both day and night shifts, and increased sleepiness in night shift (Kazemi et al., 2016). Additionally, Haidarimoghadam (2017) suggests that consecutive night shifts have a significant impact on alertness, reaction

time, as well as occupational errors. In addition to these impacts, the mental health of healthcare professionals engaged in shift work is a topic of significant concern. Burnout, an urgent issue in the healthcare industry, is particularly pronounced among shift workers. Burnout has been found more frequently in shift workers when compared to non-shift workers (Wisetborisut, 2014). Additional factors impacting burnout were being a shift worker for more than 10 years, as well as having 7 or less days off per month or sleeping less than 6 hours per day (Wisetborisut, 2014). The demands of irregular working hours, coupled with the emotional toll of patient care, contribute to heightened levels of burnout among healthcare professionals. Addressing burnout becomes paramount for sustaining a resilient and effective healthcare workforce.

Burnout Among Healthcare Workers

As healthcare professionals are often exposed to the rigors of long hours, heavy workloads, challenging shifts and heightened exposure to illness; the cumulative effect significantly contributes to burnout, often linked to depression within the healthcare field (Wisetborisut, 2014). Burnout is defined as a psychological syndrome characterized by emotional exhaustion, feelings of cynicism and reduced personal accomplishment (Koutsimani et al., 2019). The persistent strain on mental health stemming from the demands of shift work amplifies the risk of burnout among healthcare workers (Cheng et al., 2022). In this context, understanding the connection between the health implications of shift work, the increased susceptibility to burnout, and the potential manifestation of depression becomes paramount for implementing targeted interventions to support the well-being of the healthcare workforce. Exploring this scenario further, research during

the initial COVID-19 wave in Italy uncovered a substantial 25.6% burnout rate among healthcare workers (Conti et al., 2021). This was accompanied by high rates of depression (57.9%), anxiety (65.2%), and post-traumatic symptoms (55%) in the population of healthcare workers reporting burnout (Conti et al., 2021). Independently, factors such as frontline work, working in a care delivery position, and lower psychological well-being explained 38% of the variance in burnout (Conti et al., 2021).

Additionally, other studies have identified predictors of burnout that include being a younger professional, having exposure to COVID-19 patients, identifying as female, or having a history of depression (Ferry, 2020). Consequences of burnout vary but can include decreased job satisfaction and increased absenteeism. These have both been shown to correlate to diminished life satisfaction, heightened anxiety, depression, social isolation, substance abuse, and strained personal relationships outside of work (De Hert, 2020). When comparing workers with fixed night shifts to those working other shift types, night shift workers exhibited the shortest duration of sleep, the highest burnout scores, and the highest prevalence of insomnia and minor mental disorders (Cheng et al., 2016). In female workers, fixed night shifts were additionally associated with increased risks of burnout and mental disorders (Cheng et al., 2016). Understanding the intricate connection between the demands of shift work, the heightened susceptibility to burnout, and the increased likelihood of depression is pivotal for informed interventions to support the well-being of healthcare workers.

Objective

The objective of this thesis is to investigate the association between work-related, and demographic variables with self-reported depression severity and anxiety frequency among healthcare workers using the 2021 National Health Interview Survey (NHIS) data. By analyzing the impact of these factors, we can identify determinants that significantly influence the likelihood of depression and anxiety among healthcare workers.

CHAPTER TWO:

METHODS

Data source: National Health Interview Survey

The NHIS is administered annually by the National Center for Health Statistics, and acts as a pivotal tool in assessing a wide array of health-related topics. To administer data collection, in person interviews are done by trained interviewers. Responses are then recorded and weighted to accurately mirror the demographic makeup of the United States population. Over the years some of the NHIS topics and questions have changed to reflect the nature of current public health concerns, while maintaining core questions that are asked every year regardless of current events. The NHIS has been used in the past to examine various aspects of healthcare workers' mental and physical health. Previous studies using this data that also revolve around healthcare workers include topics such as occupation morbidity, (Lee et al., 2006), the implications of shift work on healthcare workers (Ceïde et al., 2015), and healthcare workers ability to maintain a healthy lifestyle (Song et al., 2020).

The 2021 NHIS included questions about participants employment, work shifts, and the industries within which they work. It should be noted that there are different rotational questions included in the NHIS each year and 2021 was the latest year to include employment questions. Additionally, participants were asked about their self-diagnosed levels of depression, anxiety, and job-related burnout levels. In this study several variables in the original data set were used in our analysis and interpretations of

our statistical models. The original variable names in the NHIS data files are included in parentheses to facilitate an understanding of what data was coded and how it was used.

Inclusion / Exclusion Criteria

For this analysis the sample adult NHIS file was used. Initially the analysis included all survey participants. To ensure sample relevance inclusion and exclusion criteria were defined. Exclusion criteria was identified by using specific demographic variables including sex, occupation, BMI, job shift, and age. If participants refused to answer these questions or their response was "not ascertained" or "I don't know" they were excluded from the analysis. If participants answered all of these questions they were included in the analysis. Prior to the final analysis, occupation was considered resulting in blue collar workers being excluded from the analysis due to more physical job demands when compared to white collar workers. The final analysis only included those who reporting working in the healthcare field.

Outcome Variables

The focus of this study was on healthcare workers and specifically evaluated their shift work on their self-reported anxiety and depression levels amidst the COVID-19 pandemic. The dependent variables in this study were: anxiety frequency (ANXFREQ_A) and depression level (DEPLEVEL_A). Both variables were coded as binary variables, while depression level was also coded as an ordered categorical variable. Anxiety frequency was coded as (1) if participants reported any frequency of anxiety ranging from "daily" to "a few times per year" and (0) otherwise. The binary outcome variable for depression level was coded as (1) if participants reported any level

of depression ranging from “a little” to “a lot” and (0) otherwise. Regarding the ordered categorical variable for depression level, this was coded in three levels that were identified by the NHIS. These levels were defined as the participant reporting that they felt “a little” depression, reporting that they felt “some” depression, and reporting that they felt “a lot” of depression. Participants only reported their depression level if they reported that they had experienced depression.

Explanatory Variables

For the analysis many variables were included that have been shown in the literature to be related to depression, working factors, family life and overall health. For each of the variables we recoded the survey responses into meaningful categorical variables. The participant’s reported sex (SEX_A) was recoded into a binary variable identifying if the participant reported that they were female (1) or not female (0). The participant’s reported occupation (EMDOCCUPN2_A) was recoded to as a binary variable indicating that the participant had a white-collar job (1) or some other type of job (0). Each participant was asked to report their BMI (BMICAT_A) which was recoded as a binary variable as overweight or obese (1), or not overweight or obese (0). Participants reported their age (AGE_P) which was recoded into three groups: young adults (18-35), middle-aged adults (35-65) and older adults (65 or older). Additional variables that were included in the analysis as binary variables are shown in Table 1.

Table 1. Explanatory variables included in the analysis.

Variable	Source name	Definition
Reported delayed medical care due to cost.	MEDDL12M_A	Medical care delayed due to cost (1) or not (0).
Reported as an active smoker.	SMKCIGST_A	Reported smoking some days or every day (1) or not some days (0).
Reported children living in household.	PCNTKIDS_A	Family has children (1) or not (0)
Reported being married.	MARITAL_A	Is married (1) or not (0)
Reported fair or poor general health.	PHSTAT_A	Health is fair or poor (1) or is not reported as fair or poor (0)
Reported current general life satisfaction	LSATIS4R_A	Satisfaction level is dissatisfied or very dissatisfied (1) or is better than dissatisfied or very dissatisfied (0)
Reported anxiety, nervousness, or worry frequency.	ANXFREQ_A	Reported daily or weekly anxiety (1) did not (0)
Reported taking prescription medication for depression.	DEPMED_A	Reported taking medication (1), or did not (0)
Reported ever being told by a doctor they had cancer.	CANEV_A	Reported they have been told they have cancer (1) did not (0)
Reported ever being told by a doctor they had COVID-19	CVDDIAG_A	Reported they have been told they have COVID-19 (1) did not (0)
Reported no health insurance coverage.	NOTCOV_A	Is not covered (1) is covered (0)

The following variables that were included in the models but were not coded as having binary outcomes and were coded with levels. Region where household is located (REGION) was recoded into four levels: South, West, Midwest, and Northeast. The participants reported racial group was coded from the RACEALLP_A variable with multiple levels including White only, Black/African American only, Asian, AIAN only, AIAN and any other group, and other or multiple races. The work shifts a participant reported working (JOBSHIFT_A) was recoded in a variable with five levels: day shift, evening shift, night shift, rotating shift, or any other shift.

Statistical Analysis Approaches

To address our research objective, we used logistic regression models as these models are used to analyze relationships between binary outcome variables and predictor variables. Data was analyzed using R (version 2022.12.0+353). Specifically, the svyolr and svyglm functions were used for logistic regression to account for the survey weights in the model as the NHIS uses complex survey designs. Statistically significant parameters were assessed using $\alpha = 0.05$. Stepwise deletion was a technique used in this study to select the most valuable or relevant predictors for our models. This technique involves iteratively removing the least significant parameter from a statistical model until only statistically significant variables remain. Stepwise deletion was required to identify the statistical model that most accurately predicted our outcome variables, considering the wide array of explanatory variables initially incorporated in the analysis.

CHAPTER THREE:

RESULTS

Descriptive Statistics

Following our inclusion and exclusion criteria, the sample size for this study was n=17,922, unweighted. After applying the data weights, the weighted sample size of the United States adult population that answered all relevant questions was 156,151,412 (Table 2). Approximately 51.11% of respondents (n=79,802,932) reported their gender as female. Approximately 50.06% of respondents (n=78,166,088) fell into the middle age category ranging from age 36 to age 65. Approximately 64.96% of adults (n=101,430,787) reported being overweight or obese. Approximately 79.06% of respondents (n=124,298,701) reported working day shift while far fewer reported working any other shift; (4.43%, n=6,916,749) reported working evening shift, (4.23%, n=6,601565) reported working night shift, (8.33%, n=13,012,075) reported working a rotating shift, (3.41%, n=5,322,324) reported working any other type of shift. Approximately 7.19% or respondents (n=11,235,042) reported that they delayed medical care due to cost. Approximately 10.84% (n=16,922,724) reported being an active smoker. Approximately 11.89% of adults (n=18,572,955) reported their general health as being fair or poor. Approximately 27.58% of respondents (n=43,064,004) reported that they experienced anxiety on a daily or weekly basis and approximately 9.86% of respondents (n=15,400,516) reported that they take prescription medication for depression. Approximately 10.47% of respondents (n=16,345,449) reported not being covered by health insurance.

Table 2. Characteristics of the NHIS adults included in the analysis.

Characteristic		Participants, weighted, n%
Age	Young (18 - 35)	51,148,677 (32.76%)
	Middle (36 - 65)	78,166,088 (50.06%)
	Elderly (66+)	26,836,647 (17.19%)
Gender	Female	79,802,932 (51.11%)
	Male	76,348,481 (48.89%)
BMI	Is Overweight / Obese	101,430,787 (64.96%)
	Is Not Overweight / Obese	54,720,625 (35.04%)
Occupation Type	White Collar	57,808,433 (37.02%)
	Not White Collar	98,342,979 (62.98%)
Job Shift	Daytime	124,298,701 (79.06%)
	Evening	6,916,749 (4.43%)
	Night	6,601,565 (4.23%)
	Rotating	13,012,075 (8.33%)
	Other	5,322,324 (3.41%)
Delayed Medical Care	Delayed Care Due to Cost	11,235,042 (7.19%)
	Did Not Delay Care Due to Cost	144,916,370 (92.81%)
Smoking Status	Active Smoker	16,922,724 (10.84%)
	Non-Active Smoker	139,228,689 (89.16%)
Parental Status	Has Children	53,292,891 (34.13%)
	Does Not Have Children	102,858,522 (65.87%)
Marital Status	Is Married	79,372,847 (50.83%)
	Is Not Married	76,778,565 (49.17%)
General Health	Fair or Poor	18,572,955 (11.89%)
	Not Fair or Poor	137,578,458 (88.11%)
Life Satisfaction	Is Dissatisfied / Very Dissatisfied	6,806,701 (4.36%)
	Is Not Dissatisfied / Very Dissatisfied	149,344,711 (95.64%)
Anxiety Frequency	Daily or Weekly	43,064,004 (27.58%)
	Not Daily or Weekly	113,087,409 (72.42%)
Depression Medication	Takes Prescription Medication	15,400,516 (9.86%)
	Does Not Take Prescription Medication	140,750,896 (90.14%)
Cancer Status	Has Been Told They Have Cancer	13,218,241 (8.47%)
	Has Not Been Told They Have Cancer	142,933,171 (91.53%)
COVID-19 Status	Has Been Told They Have COVID-19	21,422,781 (13.72%)
	Has Not Been Told They Have COVID-19	134,728,631 (86.28%)
Health Insurance Status	Is Covered	139,805,964 (89.53%)
	Is Not Covered	16,345,449 (10.47%)
Total Sample		156,151,412

Rate of Depression Among Healthcare Workers

A binary logistic regression model was used to predict the likelihood that healthcare workers reported that they experienced some level of depression in the NHIS (Table 3). Once stepwise deletion was performed on this model these were the variables that were found to be significant at alpha=0.05. Women were 1.42 times more likely to report having depression than men (95% CI: 1.011, 1.999). Those who delayed medical care due to the cost were more likely to report having depression than those who did not delay medical care due to cost (OR=2.042, 95% CI: 1.230, 3.389). Active smokers were 1.92 times more likely to report having depression than those who do not smoke (95% CI: 1.230, 2.996), Additionally, those who reported having either poor or fair general health were more likely to report having depression (OR=2.171, 95% CI: 1.305, 3.607). Those who experience anxiety either daily or weekly were more likely to have depression (OR=5.053, 95% CI: 3.629, 6.987). Those who reported engaging in shift work were found to be more likely to report depression. Specifically, when comparing against all other shift types, those who worked day shift were 1.93 times more likely to report depression (95% CI: 0.957, 3.913), those who worked rotating shift were 2.39 times more likely to report depression (95% CI: 1.106, 5.184), and those who worked evening shift were 2.58 times more likely to report depression (95% CI: 1.046, 6.399).

Table 3. Binary logit model for the likelihood that healthcare workers reported having depression in the 2021 NHIS data.

Parameter	Estimate	95% CI	SE	t-value	P-value	OR	95% CI on OR
Intercept	-1.600	(-2.360, -0.847)	0.385	-2.707	<0.001	0.2019	(0.084, 0.429)
Female	0.352	(0.011, 0.693)	0.173	1.436	0.0428	1.4219	(1.011, 1.999)
Delayed healthcare due to cost	0.714	(0.207, 1.211)	0.258	1.814	0.00589	2.0421	(1.230, 3.389)
Active smoker	0.655	(0.213, 1.097)	0.225	1.779	0.00377	1.9251	(1.237, 2.996)
Fair or poor general health	0.775	(0.266, 1.283)	0.259	1.813	0.00288	2.1706	(1.305, 3.607)
Has anxiety daily or weekly	1.620	(1.289, 1.944)	0.167	7.272	<0.001	5.0531	(3.629, 6.987)
Works day shift	0.660	(-0.044, 1.364)	0.358	1.192	0.0662	1.9348	(0.957, 3.913)
Works rotating shift	0.873	(0.101, 1.646)	0.393	1.379	0.0268	2.3941	(1.106, 5.184)
Works evening shift	0.951	(0.045, 1.856)	0.461	1.308	0.0397	2.5883	(1.046, 6.399)
Deviance:	1549.610						

Note: OR: Odds Ratio

Anxiety Frequency Among Healthcare Workers

A binary logistic regression model was used to evaluate the likelihood that healthcare workers reported that they experienced daily or weekly anxiety (Table 4). Once stepwise deletion was performed on this model these were the variables that were found to be significant at alpha=0.05. Those who delayed receiving medical care due to the cost were 2.66 times more likely to report having daily or weekly anxiety (95% CI: 1.660, 4.254). Those who reported being dissatisfied or very dissatisfied with their life were 7.53 times more likely to have daily or weekly anxiety (95% CI 3.399, 16.692). Healthcare workers who reported working day shift were significantly less likely to report having daily or weekly anxiety (OR = 0.383, 95% CI = 0.192, 0.762). Additionally healthcare workers were less likely to report having anxiety when they reported working night shift (OR=0.380, 95% CI: 0.147, 0.978), as well as having rotating shifts (OR=0.315, 95% CI: 0.139, 0.712).

Table 4. Binary logit model for the likelihood that healthcare workers reported having anxiety in the 2021 NHIS data.

Parameter	Estimate	95% CI	SE	t -value	P-value	OR	95% CI on OR
Intercept	0.158	(-0.522, 0.837)	0.345	0.456	n.s.	1.1709	(0.594, 2.310)
Delayed healthcare due to cost	0.977	(0.507, 1.448)	0.239	4.080	<0.001	2.6570	(1.660, 4.254)
Dissatisfied or very dissatisfied with life	2.019	(1.223, 2.815)	0.405	4.986	<0.001	7.5323	(3.399, 16.692)
Works day shift	-0.961	(-1.649, -0.272)	0.350	-2.742	0.00633	0.3827	(0.192, 0.762)
Works night shift	-0.969	(-1.915, -0.023)	0.481	-2.012	0.04477	0.3795	(0.147, 0.978)
Works rotating shift	-1.157	(-1.974, -0.339)	0.416	-2.780	0.00565	0.3145	(0.139, 0.712)
Works evening shift	-0.769	(-1.714, 0.175)	0.480	-1.600	n.s.	0.463	(0.180, 1.192)
Deviance:	1588.381						

Note: OR: Odds Ratio

Note: n.s. indicates that the parameter is not significant at alpha = 0.05

Depression Level Among Healthcare Workers

An ordered logistic regression model was used to evaluate the level of perceived depression that healthcare workers experienced during the COVID-19 pandemic (Table 5). An ordered logistic regression model is designed to analyze ordinal outcomes. In this case, the outcome variable consists of ordered categories lacking a numerical scale for ranking, typically referred to as subjective measures. Those who reported working night shift were less likely to report that they had more depression (OR=0.404, 95% CI 0.222, 0.736). Individuals who identify as female were less likely to report that they had more depression (OR=0.536, 95% CI: 0.35, 0.83). Individuals who report being currently married were more likely to report that they had more depression (OR=1.451, 1.035, 2.035). Those who experience anxiety daily or weekly were less likely to report having more depression (OR=0.376, 0.267, 0.530).

Table 5. Ordered logistic regression model for the level of perceived depression that healthcare workers reported in the 2021 NHIS data.

Parameter	Estimate	95% CI	SE	OR	95% CI on OR
Intercept (A Little | Some)	-2.890	(-3.422, -2.358)	0.272	0.056	(0.033, 0.095)
Intercept (Some | A Lot)	-0.777	(-1.268, -0.286)	0.250	0.460	(0.281, 0.751)
Works night shift	-0.906	(-1.505, -0.307)	0.306	0.404	(0.222, 0.736)
Female	-0.624	(-1.063, -0.185)	0.224	0.536	(0.345, 0.831)
Is currently married	0.372	(0.034, 0.711)	0.173	1.451	(1.035, 2.035)
Has anxiety daily or weekly	-0.978	(-1.321, -0.635)	0.175	0.376	(0.267, 0.530)
Deviance:	1281.561				

Note: OR: Odds Ratio

CHAPTER FOUR:

DISCUSSION

Principal Findings

The objective of this paper was to investigate the association between work-related, and demographic variables with self-reported depression severity and anxiety frequency among healthcare workers using the 2021 NHIS data. To address this objective, data from the NHIS was analyzed to identify the factors that are significantly associated with depression and anxiety. The depression and anxiety variables were defined from a section of the NHIS that focused on mental health related variables. Healthcare workers were defined based on their self-reported occupation in the NHIS. In general, when controlling for factors known to impact depression and anxiety in healthcare workers, our results suggest that when healthcare workers reported working day, evening, or rotating shifts they were more likely to report that they had depression. However, when healthcare workers reported working day, night, or rotating shifts they were less likely to report having anxiety. Additionally, of those healthcare workers who reported depression at all, they were less likely to report severe depression when they reported working night shifts.

The results that suggest healthcare workers who work evening or rotating shifts are more likely to report depression are consistent with the literature that suggest that work shift impacts a worker's mental health. Contrary to our findings, it has been suggested that healthcare workers in Saudi Arabia that work night shift were more depressed than those working day shift (Alreshidi et al., 2023). More generally across all

workers, it has been found that a disruption of a normal circadian rhythm via shift work leads to a higher prevalence of depression (Germain & Kupfer, 2008). Our model also suggested that female healthcare workers were more likely to report being depressed and other studies have also shown similar gender effects (Pappa et al., 2020). Healthcare workers who delayed medical care were more likely to report depression. Those who reported delaying medical care were 2.04 times more likely to report that they experienced depression. Other studies showed that among middle aged adults, those who delayed medical care were found to have higher rates of depression (Gonzalez et al., 2021). Elderly adults who delayed care were also more likely to be depressed (Luo, 2021). Our study also found that individuals who delayed medical care were 2.66 times more likely to experience anxiety which is in line with this research. Additionally, Shukla et al., (2022) found that those who delayed in person care were more likely to report that they experienced anxiety, particularly if they felt like they were vulnerable to COVID-19.

During the first year of the COVID-19 pandemic anxiety was shown to be extremely prevalent in healthcare workers (Setiawati et al., 2021). Our results showed that among healthcare workers those who experienced daily or weekly anxiety were more likely to report being depressed. Other studies have shown similar findings where anxiety and depression are found to be correlated (Sahebi et al., 2021). Additionally, it was found that those who were either dissatisfied or very dissatisfied with their life were more likely report having anxiety. This finding is consistent with literature that has used participants anxiety level to predict their life satisfaction (Serin et al., 2010). Our study also found that individuals that report being active smokers were more likely to be depressed.

Weinberger (2017) found that those who were active smokers were more likely to be depressed which is in line with our findings. Lastly, it was found that those with fair or poor general health were more like to be depressed which is in line with the work of Reklaitiene et al. (2014). This study found that if perceived health was poor the prevalence of depressive symptoms was higher, the findings were even more significant among women than men which is echoed in the findings of Table 3.

Limitations

There are several limitations of this study that future research should aim to address. First, the NHIS was not specifically focused on healthcare workers but did ask questions about employment. Thus, we were able to identify healthcare workers, but there may be other people who work in the health care sector that we inadvertently omitted from the analysis. Future research should specifically target healthcare workers to build on the existing literature related to shift work in this domain. Additionally, the prevalence or relationship between anxiety and depression was not a primary focus of the NHIS, but there was a section about mental health, therefore future research should evaluate the prevalence and further elucidate the contributing factors to depression and anxiety in this population of workers.

Additionally, the NHIS relies on self-reported data. In our study this pertains to the outcome variables of anxiety and depression. Self-reporting may introduce bias in responses as participants may over or under report their symptoms due to many different factors such as social perception or occupational desirability. Recall bias may have also been present and may have influenced the accuracy of responses when participants were

asked to recall past experiences. Another limitation of the self-reporting nature of the NHIS is that participants may have different interpretations of terms like anxiety or depression; it is possible that they may be unaware of their symptomology entirely. All limitations surrounding the self-reporting nature of the NHIS could be addressed in future work by utilizing a variety of study designs and data sources to describe this population and these issues more fully. Thus, providing a more comprehensive understanding of the mental health status of healthcare workers.

In addition, when inclusion/exclusion criteria were applied responses were omitted if participants did not answer simple demographic questions. This may have led to a portion of the population that reports depression being omitted from the final data analysis. Future studies could consider ways to overcome both the self-reported nature of these surveys as well as the possibility of missing or underreported data. Lastly, this study did not differentiate between various healthcare settings such as hospitals, clinics, or long-term care facilities. Each of these settings may have different work environments, job demands, or stressors because of the caseloads (Brems et al., 2007), the patent characteristics (e.g., different services provided) (Scanlan & Still, 2019), or the staffing levels (Needleman et al., 2002). Future research should evaluate specific subgroups of healthcare workers such as frontline workers, administrative staff, or technicians within these different healthcare environments. This would provide a more comprehensive examination of the impact that role, environment, and other factors that impact healthcare workers' job-related mental health issues.

Conclusions

As the demands on healthcare networks in the United States continue to increase and evolve (Mantaleon, 2023) it is critical to understand how the nature of work in the healthcare field impacts employee's mental health (Mijakoski et al., 2015). This study examined the prevalence of depression and anxiety rates among healthcare workers using the 2021 NHIS data. As expected, this study found that shift work increases the rate of depression in a healthcare worker population if workers engage in day shift, evening shift or rotating shift. Healthcare employees that work night shift were also found to be more likely to have at least some depression. This finding specifically regarding night shift is important as it directly relates to SWD which can be started by working during typical sleep times (Brown et al., 2020). As depression and burnout have been shown to be linked (Conti et al., 2021), the findings of the analysis convey that healthcare employees who engage in some form of shift work are at an increased risk of experiencing burnout symptoms. Additionally, healthcare workers who are married were more likely to report a higher level of depression. This finding is significant when coupled with the shift work findings as these employees are likely experiencing burnout which has been shown to strain personal relationships (De Hert, 2020). To support these workers and ultimately retain them, employers should focus on allowing workers to maintain positive work-life balance to reduce stress and improve mental health (Albertsen et al., 2014). Albertson (2014) has also shown that self-rostering, as well as schedule predictability (Barnes-Farrell et al., 2008) can improve work-life balance. This may also aid in preventing the failing physician to patient ratio found by Zhang (2020). This study also revealed some

unexpected results such as healthcare workers who work day shift, night shift or rotating shift were all less likely to be anxious.

These findings are important as they can inform the policies and support that healthcare workers require. Interventions aimed at improving shift work schedules by taking mental health into consideration are critical to job satisfaction from the employees' perspective and ultimately staff retention from the administration perspective. Healthcare workers are not immune from the current mental health crisis (Vizheh et al., 2020) and more work needs to be done to support them, especially as shift work is foundational to being able to provide care to patients. This study reveals how intricate factors such as demographics and the strain of shift work affect the mental health of healthcare workers. By recognizing and addressing these challenges we can ensure the wellbeing of healthcare workers and sustain a resilient workforce. Interventions designed to support the mental health of healthcare workers as part of employee recruiting and retention efforts will likely need to explore different types of interventions for workers that work different shifts as the likelihood of anxiety and depression associated with shifts differs.

Future studies should further investigate the relationship between shift work and mental health; specifically focusing on how an adverse mental health status can impact work tasks. It has been shown that adverse mental health can directly impact quality of work that is done (Wang et al., 2004). Future research should also attempt to address which specific healthcare occupations are most at risk for developing adverse states of mental health. This analysis was limited to a broad scope of healthcare workers and it is known that different occupations have different job demands (Brems et al., 2007). Lastly,

human factors and systems engineering studies should be conducted to identify how different interventions (and potentially different interventions for different shifts) can both improve the outcomes of shift work on healthcare workers mental health and ensure patient safety and high-quality care. These workers are vital to ensuring that we stay healthy as a population and more work needs to be done to support them.

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