

Psychosocial Hazards at Work: Organizational Stressors, Interpersonal Exposures, and Mental  
Health across U.S. Working Populations

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**Abstract**

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Mental disorders, such as depression and anxiety, are leading causes of disability among working adults worldwide. Psychosocial hazards at work are increasingly recognized as modifiable determinants of worker mental health, with interpersonal exposures including bullying, harassment, and violence among the most strongly associated with adverse mental health outcomes. Herein, we present three studies examining occupational psychosocial hazards as they relate to mental health and intermediate psychosocial stressors across U.S. working populations, with two studies focused on U.S. mariners and a third extending to the broader workforce.

First, we conducted a content analysis of open-ended survey responses from U.S. mariners (n = 478) during the COVID-19 pandemic to characterize worker-identified stressors and solutions. Inadequate shoreside support was the most frequently identified stressor (12.3%), followed by

inability to disembark (10.2%) and ineffective or unnecessary controls (9.9%). Female mariners more frequently reported economic uncertainty and inability to disembark as stressors, while younger mariners more frequently reported extended voyages as a stressor. Overall, the findings suggest a need for equitable application of emergency protocols, processes to preserve shore leave, consistent communication between shoreside employers and vessels, and mechanisms to address workforce wellbeing through compensation and recognition.

Next, we used latent profile analysis to characterize the interpersonal work environment among U.S. mariners ( $n = 422$ ) and tested its associations with mental health and intent to leave the maritime industry. Three profiles emerged: Supportive (64.2%), Isolating (19.4%), and Hostile (16.5%). Compared to the Supportive profile, the Hostile profile was associated with 5.62-fold higher odds of likely depression (95% CI: 2.76, 11.43) and 4.81-fold higher odds of likely anxiety (95% CI: 2.38, 9.72), while the Isolating profile was associated with 2.77-fold higher odds of likely depression (95% CI: 1.45, 5.28) and 3.36-fold higher odds of likely anxiety (95% CI: 1.79, 6.32). After adjustment for job satisfaction and mental health, the observed association between profile membership and intent to leave was attenuated to nonsignificance.

Finally, using linked 2023 National Health Interview Survey and Occupational Information Network data, we examined whether occupation-level exposure to unpleasant or violent contact in the workplace was associated with experiences of discrimination and heightened vigilance among full-time U.S. workers ( $n = 12,462$ ). Exposure to violent contact was associated with higher vigilance ( $\beta = 0.076$ ; 95% CI: 0.013, 0.140) but not discrimination, while exposure to unpleasant contact was not associated with either outcome. Women, Black, and sexual minority workers were each overrepresented in occupations exposed to violent contact.

The work presented here characterizes psychosocial hazards in U.S. working populations and identifies intervention points for protecting worker mental health and retention. Across these studies, the interpersonal work environment emerged as a source of both harmful exposures (eg, bullying) and protective ones (eg, peer support) at the occupational level, while individual characteristics were simultaneously strongly associated with the outcomes under study. Therefore, addressing interpersonal exposures requires intervention at multiple levels. For mariners, this means reducing the conditions that produce hostile climates through adequate crewing and leadership accountability, while building supportive climates through team building and structured peer support. For the broader workforce, it means combining organizational design and policy for violence prevention with crisis debriefing and de-escalation support. These findings strengthen the case for a federal workplace-violence prevention standard for general industry.

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I must thank my husband, Clayton Aldern, whose belief in me is boundless, whose curiosity rivals my own, and with whom anything is possible.

## **Dedication**

To Dad – I would prefer if you were here to see me become the first in our lineage to get a doctorate, but you would hate all the traffic, and I am sure the view is much better from Heaven.

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## Chapter 1: Introduction

Mental disorders are leading causes of disability worldwide.<sup>1-3</sup> Mental disorders, frequently referred to as mental health conditions, are clinically significant disturbances to one's cognition and emotional regulation, such as depression, anxiety, post-traumatic stress disorders (PTSD), and eating disorders, among others.<sup>4</sup> A total of 3.5 billion people are part of the global workforce,<sup>5</sup> and an estimated 15% of working-age adults experience a mental disorder at any point in time.<sup>3,6</sup> Depression and anxiety alone account for an estimated 12 billion lost workdays each year, which corresponds to a cost to the global economy of nearly \$1 trillion in lost productivity.<sup>6</sup> After declining modestly from 1990 to 2019, the prevalence of mental disorders rose sharply during the COVID-19 pandemic.<sup>1</sup> Both depression (21.4%) and anxiety (18.2%) prevalence among U.S. adults remained significantly higher in 2022 than in 2019.<sup>7</sup>

Work is a recognized social determinant of health.<sup>8-10</sup> The organizational and regulatory structure of work has substantial implications for population health.<sup>11</sup> Occupational health practice has historically focused on hazards affecting physical health, though there has been renewed attention on mental health alongside physical health as a core occupational health concern in the wake of the COVID-19 pandemic.<sup>6</sup> As of 2023, however, only 35% of countries report having national programs for work-related mental health promotion and prevention.<sup>3</sup> Recent guidance from the U.S. National Institute for Occupational Safety and Health (NIOSH) emphasizes the need to integrate mental health into occupational safety and health practice and identifies work-related psychosocial hazards as modifiable determinants of mental health.<sup>12</sup> Herein, we present three studies examining occupational psychosocial hazards as they relate to mental health and intermediate psychosocial stressors across U.S. working populations, with two studies focused specifically on U.S. mariners and a third extending to the broader workforce.

Within occupational health, psychosocial hazards are aspects of the design and management of work, along with the social and physical environment, that have potential to cause psychological or physical harm.<sup>13</sup> Whereas physical, chemical, and biological hazards act on health through direct exposure-response pathways,<sup>14</sup> psychosocial hazards operate primarily through stress-mediated pathways that produce both mental and physical health effects.<sup>15</sup> Psychosocial hazards span multiple aspects of work, including job content, workload and schedule, environmental conditions, organizational culture, and interpersonal relationships, among others.<sup>12</sup> The prevalence and effects of these hazards are increasing in the United States as working conditions change,<sup>16</sup> placing growing demands on occupational health practice to address them.

A framework frequently applied when discussing psychosocial hazards, Total Worker Health (TWH)<sup>17</sup> is the NIOSH approach to integrating occupational health, safety, and worker well-being. Within this approach, the Total Worker Health Hierarchy of Controls (TWH HOC)<sup>18</sup> adapts the traditional hierarchy of controls<sup>19</sup> to prioritize control measures to advance overall worker well-being, as well as health and safety. In the TWH HOC, elimination of negative working conditions are prioritized as most effective, whereas encouragement of safe and healthy practices is less effective.<sup>12</sup> Controls at the organizational level are generally favored as more effective, efficient, and sustainable than individual-level approaches.<sup>12,20</sup>

Adverse psychosocial work conditions are associated with the onset of common mental disorders.<sup>10,21,22</sup> Decades of prospective and longitudinal evidence have consistently linked poor psychosocial work environments (i.e. high psychological demands, low social support, low decision latitude) to subsequent mental disorders, including depression and anxiety.<sup>23,24</sup> Recent work calls for more robust causal-inference studies to bolster our understanding of risk and

protective factors and mechanisms of action for work-related determinants of mental health, including the psychosocial work environment.<sup>10</sup>

Among psychosocial hazards, interpersonal exposures, such as violence, bullying, and harassment, carry some of the strongest effects on workers' mental health.<sup>25</sup> These exposures show a dose-response pattern among nurses, with greater cumulative exposure associated with higher odds of adverse mental health outcomes.<sup>26</sup> Workplace bullying is consistently associated with adverse mental health outcomes,<sup>27,28</sup> including in prospective studies where baseline bullying predicts subsequent mental health symptoms.<sup>27</sup> A study of U.S. public health workers exposed to workplace violence during COVID-19 found elevated prevalence of depression, anxiety, PTSD, and suicidal ideation.<sup>29</sup> While the research into these exposures is increasing, there is still a need for standard theoretical models<sup>30</sup> and multi-level and multi-model research approaches<sup>31</sup> to better capture the complex interrelationships of environmental context, working relationships, and individual worker characteristics.

Beyond violence and harassment, workplace discrimination is another psychosocial stressor with well-documented mental and physical health consequences.<sup>32–34</sup> Self-reported experiences of discrimination are known to be associated with mental disorders and adverse physical health outcomes across cross-sectional and longitudinal studies.<sup>32</sup> Further research indicates that perceived workplace discrimination is negatively related to job attitudes, physical health, and psychological health.<sup>33</sup> Heightened vigilance (anticipation of and preparation for discrimination or harassment) functions as a chronic psychosocial stressor, with Black adults reporting higher vigilance than White adults.<sup>35</sup> While the health effects of discrimination and vigilance are established, the occupational determinants of these experiences, including whether structural features of certain jobs increase exposure to them, remain understudied.

Coworker and supervisor support can serve as protective factors against psychosocial hazards. Coworker support buffers the association of bullying and harassment with mental health at the level of the individual.<sup>36</sup> Supervisor support, however, operates at the organizational level by influencing organizational policies and practices.<sup>37</sup> In fact, supervisor training in mental health strategies is among the few evidence-based organizational interventions with positive effects on employee mental health.<sup>37</sup> These interpersonal supports, alongside other dimensions of the psychosocial work environment, shape job satisfaction. Job satisfaction in turn is associated with both retention and mental health, connecting psychosocial hazards to workforce outcomes especially salient for sectors strained by labor shortages.<sup>12,21</sup>

The burden of these hazards is not distributed evenly across the U.S. labor force.<sup>38-40</sup> Distributions of adverse psychosocial exposures are patterned by gender: women in the United States are concentrated in service and care occupations characterized by frequent direct contact with customers, clients, and patients,<sup>41</sup> and bear the majority of nonfatal violence injuries requiring time off work.<sup>42</sup> They are also more likely than men to be precariously employed<sup>43</sup> and to experience the adverse mental health effects of precarious employment.<sup>44</sup> Exposure to psychosocial hazards is higher in service and care work, which is predominantly done by women, whereas exposure to physical and chemical hazards is higher in manual and industrial work which is predominantly done by men.<sup>41</sup> These gendered exposure profiles are reflected in measurable occupational health disparities.

Race and ethnicity also shape psychosocial exposures. Occupational segregation by race and ethnicity concentrates marginalized workers in jobs with greater exposure to job strain (high psychological demands and low autonomy) and harassment, with cumulative effects that compound across the life course.<sup>38,39</sup> High-strain occupations are also associated with decreased

cognitive functioning among older individuals, disproportionately affecting Black and Latino workers.<sup>45</sup> These same racial/ethnic groups report higher exposure to job insecurity and harassment than non-Hispanic White workers, even after adjustment for industry and occupation.<sup>39</sup> These patterns reflect the structural sorting of workers into jobs rather than individual differences in skills or preferences.<sup>38</sup>

Two of the three studies in this dissertation focus on U.S. mariners, an essential workforce that faces unique working conditions. There are estimated to be around 12,000 actively sailing U.S. mariners qualified to crew oceangoing vessels.<sup>46</sup> Mariners frequently face extended periods at sea, separation from family and support networks, and long hours.<sup>47</sup> Mental health is of concern in the global maritime workforce where there is a higher prevalence of mental disorders compared to the general working population, with recent estimates placing prevalence of depression and anxiety at 38.8% and 56.7% respectively.<sup>48</sup> Mariner retention is also of present concern to the industry: the 2023 officer supply deficit was the highest in 17 years of tracking, and shortfalls are projected to persist through 2028.<sup>49</sup> Though high prevalence of mental health symptoms was observed among U.S. mariners during the pandemic,<sup>50</sup> additional qualitative research into specific stressors and the solutions identified by mariners is needed to inform future actions. Further, the relationship between the psychosocial work environment, particularly interpersonal exposures, and mariner mental health and retention also requires more attention. Both of these needs are addressed herein.

This dissertation examines psychosocial hazards across U.S. working populations through three empirical studies. Chapter 2 presents a thematic content analysis of open-ended survey responses from U.S. mariners during the COVID-19 pandemic to characterize worker-identified stressors and solutions, with implications for organizational and policy responses to future emergency

scenarios. Chapter 3 uses latent profile analysis to characterize the interpersonal work environment among U.S. mariners and its associations with mental health and intent to leave. Chapter 4 uses nationally representative data to examine whether occupation-level exposure to unpleasant and violent contact is associated with experiences of discrimination and vigilance among people across the U.S. workforce.

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## **Chapter 2: Occupational Stressors among U.S. Maritime Workers during the COVID-19 Pandemic: A content analysis by age and gender**

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### **2.1 Introduction**

The maritime industry serves as a critical component of global commerce and the United States economy, facilitating international trade and supporting over 30 million jobs while contributing more than \$5.4 trillion to the national economy.<sup>1</sup> As of November 2024, the United States Bureau of Labor Statistics estimated approximately 73,600 workers in the water transportation subsector (NAICS 483); this number includes captains, mates, and pilots of water vessels, sailors and marine oilers, ship engineers, ship operations personnel, and freight, stock, and material movers.<sup>2</sup> Mariners working on vessels face multiple occupational hazards, ranging from physical hazards (eg, heavy lifting, slippery surfaces) and chemical exposures (eg, cargo, cleaning agents, solvents, fuels) to unique psychosocial stressors that vary by vessel type and operation.<sup>3</sup> For instance, mariners on oceangoing vessels commonly follow a 12-hours-on, 12-hours-off schedule, while those in the tug and towboat industry often operate on 6-hour rotating shifts.<sup>4,5</sup> These irregular schedules, combined with extended work hours often exceeding 70 hours per week, can disrupt circadian rhythms and impact sleep quality.<sup>6</sup> Additionally, vessel connectivity varies substantially, with many ships having limited or inconsistent access to internet and telephone services, restricting communication with family and support networks ashore.<sup>7</sup>

The impact of these and other occupational conditions on mental health deserves further study, though some research has previously looked at the mental wellbeing of maritime workers both in

the USA and internationally. A cross-sectional study of 1,572 international seafarers in 2019 found elevated rates of depression (25%) compared to the US general population (8%).<sup>8</sup> These findings were supported by Hayes-Mejia and Stafström's 2023 study of 17,861 international seafarers, which identified associations between workplace conditions and mental health outcomes; specifically, safety consciousness and clear communication from employers were associated with better mental health outcomes.<sup>9</sup> A 2023 systematic review further documented that seafarers face unique psychosocial stressors due to their working environment, though the review noted a lack of standardized mental health assessment methods in maritime settings.<sup>10</sup> Despite the recognized impact of these occupational stressors on mariner mental health, research specifically focusing on U.S. mariners remains limited, particularly regarding how these impacts and outcomes may vary across different demographic groups.

The COVID-19 pandemic introduced additional challenges to the maritime industry's existing operational environment. During this period, global travel restrictions led to what became known as the crew-change crisis, which affected the approximately 400,000 seafarers globally who remained on vessels beyond their original contracts.<sup>11</sup> Research conducted during the pandemic documented specific workplace changes that impacted U.S. mariners, including modified crew change protocols, restricted shore leave, and altered vessel operations. A survey of 1,384 U.S. mariners who worked during the pandemic found associations between COVID-19-related workplace changes, such as longer contract lengths and lack of shore leave and mental health outcomes (depression, anxiety) and stress.<sup>12</sup> Additionally, Hayes-Mejia and Stafström's analysis of international seafarers revealed that delays in crew changes, stemming from national quarantine guidelines and travel restrictions, negatively impacted crew well-being.<sup>9</sup> These data also highlighted a difference in mental health outcomes between onboard and shoreside workers,

with those working onboard ships having worse outcomes. These findings suggest that while the pandemic created new challenges for maritime operations, various workplace factors may have influenced how these challenges affected the workforce.

Certain demographic groups within the maritime industry face distinct occupational experiences that warrant focused research attention. Comprehensive data on women's representation in the U.S. maritime workforce is limited; in 2021, a survey of maritime companies estimated that the proportion of female seafarers by country of company headquarters was 6% for the United States.<sup>13</sup> A 2024 survey of international seafarers identified key challenges for women in the industry, which included gender discrimination in employment, which 29% of women reported as a major obstacle compared to 0.4% of men.<sup>14</sup> Age-related differences also emerge in occupational experiences: a 2019 cross-sectional study of 575 mariners from a global shipping company found higher reported levels of stress and anxiety among younger workers, particularly related to adaptation to maritime environments and separation from support networks.<sup>15</sup> Similarly, the 2022 study by Yassin et al. noted elevated rates of depression, anxiety, and post-traumatic stress disorder (PTSD) among U.S. mariners ages 25-34 as compared to older mariners, potentially attributed to age-specific stressors such as family-rearing responsibilities.<sup>12</sup> These demographic variations in occupational experiences suggest the need for targeted research to understand and address group-specific challenges within the maritime industry.

While existing research has documented mental health challenges in the global maritime sector largely using surveys, significant gaps remain in understanding how these issues manifest within the U.S. maritime context, particularly regarding demographic variations in occupational experiences and what solutions may be most impactful to mariners. The present study uses a content analysis to explore how COVID-19 pandemic stressors impacted U.S. mariners, and the

challenges and solutions mariners identified related to these stressors utilizing open-ended response data from a nationwide survey (Yassin et al.). Through thematic content analysis of this open-ended survey data, we identify and compare challenges and solutions offered by mariners sailing during COVID-19, and how they differ by gender and age. Findings from this study contribute to the growing body of literature on occupational health in the maritime sector while providing evidence-based insights for developing targeted interventions to improve mariner health and wellbeing.

## **2.2 Methods**

The population of interest in this study was both credentialed and non-credentialed U.S. mariners who sailed during the COVID-19 pandemic (from 1 March 2020). Survey respondents were required to be U.S. citizen or permanent resident merchant mariners working on U.S.-flagged vessels. This study was a collaboration between University of Washington and researchers from the National Institute for Occupational Safety and Health (NIOSH) and was guided by a working group consisting of representatives from the U.S. Committee on the Marine Transportation System (CMTS) COVID-19 Working Group, the U.S. Department of Transportation Maritime Administration (MARAD), and the Ship Operations Cooperative Program (SOCP). The University of Washington Human Subjects Division determined this project to be exempt from review, as researchers were collecting no identifying information. This study adhered to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cross-sectional studies, and the checklist is available as supplemental material to this manuscript.

### **Survey Design and Implementation**

The results presented here are analysis of the single open-ended question included on the parent survey assessing mariner mental health during COVID-19. The open-ended question included in this content analysis asked respondents: “Is there anything else you would like to let us know about your experience with COVID-19 aboard your vessel?” The full parent survey has been previously described (Yassin et al.), but included validated questionnaires to assess depression, anxiety, and perceived stress, in addition to asking about job satisfaction, concerns related to COVID-19, and other experiences sailing during COVID-19. Details and findings from the parent survey have been previously published.<sup>12</sup> The parent survey was developed and distributed through the web-based data management and survey tool REDCap hosted at the University of Washington.<sup>16</sup> The objective of the parent survey was to collect information on the experiences and concerns of US mariners sailing during the COVID-19 pandemic, specifically in regard to workplace factors related to COVID-19 that may impact mental health. The survey was open online to all US mariners who met the inclusion criteria from 25 January 2021 through 31 July 2021 and was completed by n= 1,384 US mariners. For the open-ended response question analyzed qualitatively in this paper, there were n = 478 respondents; no respondents were excluded from the analysis. Responses were linked to self-reported demographic information, including gender, age, maritime position, and type of vessel they sail on.

### Data Coding and Analysis

The study team used inductive coding approaches with a content analysis methodology in the analysis of responses, with particular attention to identifying patterns in how different demographic groups experienced and responded to pandemic-related workplace changes.<sup>17</sup> Given that each response was relatively short, researchers began by reading through each response and taking notes on the major categories that emerged from respondent answers. After

two coders reviewed these notes together, a preliminary codebook was developed that integrated these categories. A final codebook was created based around two main code groups: stressors and solutions. The stressors code group included codes to systematically capture responses that referred to things the respondent did not like when sailing during COVID-19 or things that caused them stress, frustration, or discomfort. This included subcodes to capture unjust, ineffective, or needed policies and practices, controls put in place that caused worker stress, extended time on the vessel, political climate surrounding COVID-19, inadequate shoreside support, mentions of adverse mental health, and stressors related to the homefront or family life. The solutions code group was loosely based on the NIOSH hierarchy of controls framework<sup>18</sup> and included subcodes to capture responses that referred to positive (or negative) attributes of existing controls, recommendations for additional controls, and other solutions to ameliorate the stressors experienced by mariners such as increased compensation or increased recognition from shoreside or the general public.

The codebook was inductively edited during the analysis to include and refine specific subcodes that captured frequently occurring sentiments among respondents. The coding process was conducted concurrently by two study team members, from here on referred to as coders. Using the co-developed codebook, coders independently coded the same randomly selected 30 responses, then met to discuss application of the codebook and inductively edit it. Coders repeated this process two more times, independently coding the same 30 responses, comparing code applications and adjudicating coding discrepancies until consensus was achieved and inter-coder reliability reached 90 percent. This iterative process ensured the codebook was consistently being applied in the same manner between the two coders. After co-coding 20% of total responses, the remaining responses were split between the two coders for coding, with a

final meeting at the completion of coding to adjudicate any responses that didn't feel straightforward or benefitted from additional discussion to code accurately. Coders could assign more than one applicable code to each response, and coded responses ranged in length from a short sentence to multiple paragraphs, with most survey responses being a few sentences in length. The full codebook is presented in Table 2.

The resulting data from the coding process, in conjunction with occupational and demographic data collected in the initial survey, were analyzed using a content analysis protocol for overall and relative frequencies of codes, specifically between substrata in the study population defined by age, sex, vessel type, and maritime credential status. Data analysis was conducted in Key excerpts from responses were then used to summarize key themes and support observed codes with illustrative context.

## **2.3 Results**

There was a total of  $n = 478$  open-ended responses coded. Table 1 summarizes the demographic characteristics of respondents. The sample was predominantly male (81.8%) and licensed mariners (69.6%), with approximately one-third of respondents over age 55 (33.5%). Government/public vessels were the most common vessel type represented (31.6%).

A total of 840 codes were applied across the responses, with stressors ( $n=692$ , 82.4%) reported more frequently than solutions ( $n=101$ , 12.0%). A portion of the responses were classified as non-codable ( $n=47$ , 5.6%), indicating that the response did not align with any code in the codebook. Among stressors, inadequate support from shoreside was the most frequent code ( $n=103$ , 12.3%), followed by inability to disembark ( $n=86$ , 10.2%), and ineffective or unnecessary controls ( $n=82$ , 9.8%). The most common solution codes applied were effective existing controls

(n=31, 3.7%), vaccines (n=29, 3.5%), and increased compensation (n=15, 1.8%). Table 2 details the frequencies of assigned codes overall, by gender (male, female), and age (18-34, 35-54, 55+), along with illustrative quotes for each code.

As shown in Table 2, code frequencies were observed to vary between gender and age groups. Inability to disembark (stressor) was applied more frequently to responses from female mariners than males (14.2% vs 9.4%). Economic uncertainty (stressor), which includes fears of being laid off and insufficient pay or work, was also applied more frequently to responses from female mariners than males (7.5% vs 4.8%). Long/extended voyages (stressor) was applied most frequently to responses from younger mariners (18-34), especially when compared to mariners over the age of 55 (8.8% vs 2.8%). Unjust application of COVID policies and practices appeared less frequently among females and 18–34-year-olds, with 3.8% and 4.8% respectively, compared to 6.3% overall.

Figure 1 visualizes how the top 5 most frequently assigned codes by gender and age groups are shared between demographic groups. Inability to disembark, inadequate support, and ineffective controls occurred in the most frequently assigned codes across all gender and age groups. Extended voyages occurred as a top code among males, 18–34-year-olds, and 35–54-year-olds. Stress from general COVID-related work changes was a top code among females, 18–34-year-olds, and 35–54-year-olds. Unjust application of COVID policies and practices was a top code among males, 35–54-year-olds, and those aged 55+. Economic uncertainty was a top code among females and those aged 55+. Finally, effective existing controls and needed COVID controls are lacking were top codes only for those aged 55+.

## 2.4 Discussion

The findings reveal that maritime workers experienced multiple workplace stressors during the COVID-19 pandemic, with inadequate organizational support emerging as the predominant concern. Here we discuss significant code categories that emerged from the content analysis and offer actionable suggestions for industry leaders that could improve maritime worker health and safety. The high occurrence of inadequate support as a code in responses across demographic groups indicates a disconnect between vessel and shoreside operations during crisis responses. Responses pointed to practical challenges in obtaining basic supplies (i.e., soap, toiletries, and sanitizer) and maintaining communication with shoreside operations. The frustration with inadequate support from shoreside operations is exemplified by this response: "Mariners feel like numbers on a spreadsheet pushed around to get the mission done, not people with lives of their own. We understand that it is a difficult time, but a little outreach from the shoreside office would go a long way." These reported experiences align with Hayes-Mejia and Stafstrom's 2023 study, which found that employers' ability to communicate effectively and transparently with seafarers was associated with better mental health outcomes during the COVID-19 pandemic.<sup>9</sup> In order to address this commonly identified stressor, maritime companies and organizations may seek to implement consistent communication protocols, give acknowledgment to the stress Mariners face in their roles, provide recognition (either monetary or other) to mariners, and ensure Mariners have access to necessary supplies.

The inability to disembark and extended voyages were also frequently coded as stressors among the mariner responses. Respondents noted being unable to go ashore to buy items to offer some personal enjoyment or even take a walk to clear the mind, as well as feeling contained to the vessel for 6+ months. These responses echo results from other studies, including a similar

qualitative study of international seafarers wherein responses likened the experience of being stuck onboard ships to feeling like prisoners.<sup>19</sup> Extended voyages and inability to disembark, as measured by length of time onboard, were shown to increase mental health outcomes and fatigue in another study of international seafarers.<sup>20</sup> Responses from mariners in this study indicate that extended voyages may also impact retention in the industry; as one Mariner stated: “I am 130 days overdue for relief. Add 2 months to that since I need to give the Maritime Safety Committee 2 months’ advance notice of my requested relief date. Unacceptable! I have no plans of returning back to work after I get relieved.”

The impacts of extended time spent onboard and the inability to go ashore was a top stressor mentioned by younger mariners (18-34) compared to those over 55, suggesting potential age-specific vulnerabilities to prolonged deployment. This could be due to younger mariners lacking some of the resiliency that older mariners have developed over their longer careers, younger mariners having different stressors both on and off the vessel (eg, they are more likely to have younger families at home who could be navigating school/day care closures, or they may be more accustomed to having access to internet or social media for communication than older mariners would be) or younger and thereby newer mariners not having access to preferential schedules and vessels like the older mariners who may have scheduling seniority. Future research focusing on the needs and experiences of younger or newer mariners will be valuable not only for ensuring their well-being at work, but also for improved recruitment and retention of younger mariners by maritime companies, which remains a priority.<sup>21</sup> Older mariners (55+) were more likely to comment that the existing controls were effective or comment that COVID-19 controls were lacking compared to younger mariners. This is supported by broader pandemic research showing that older populations demonstrated higher risk perception and compliance

with preventive measures.<sup>25</sup> The co-occurrence of these codes within respondents can be seen in this response from a 55+ year old mariner: “The ship is feeling safer with mask wearing at all times. Not enforcing mask wearing was highly dangerous.”

The analysis also revealed demographic variations in common stressors by gender, with female-identifying mariners being more likely to comment on the stressors of economic uncertainty and inability to disembark the vessel than their male counterparts, but less likely to comment on the stressors of the ineffectiveness or unjust application of COVID-19 controls. This may reflect broader pandemic-driven gender disparities in employment security and experiences, as women were disproportionately economically impacted by the pandemic. Female unemployment increased by 4.2% compared to 3.0% for men, and women faced a 24% higher likelihood than men of permanently losing their jobs during the pandemic.<sup>22,23</sup> Some of this disparity was due to the increase in at-home caregiving responsibilities during COVID-19, largely undertaken by women, attributable to school and day care closures, and increased care needs for older and vulnerable individuals.<sup>24-26</sup> One female mariner commented on the interplay between caregiving and economic uncertainty: “For me, as for many others, the effects suffered by the pandemic have been financial rather than health. I am VERY grateful to have this job, and to be onboard for as long as my company needs me. My family and friends that have lost their jobs due to the overreaction by the government to this disease all rely on my paycheck. The government has not stepped up...to help the residents, so it's up to myself and others like me who will take a job like this to keep money coming to those that have had their ability to support themselves stripped from them.” However, the relatively small number of female-identifying mariners who responded to this survey (n=55) makes it challenging to draw broad conclusions for female mariners. Importantly, these responses would not reflect the experiences of women who were

not able to continue sailing during COVID-19 due to changes in their employment status due to increased caregiving responsibility or other pandemic-related factors.

The findings point to several mariner-identified solutions that could improve experiences during public health emergencies. While testing and vaccination emerged as important controls, mariners also emphasized the need for increased compensation to reflect heightened risks and challenges, particularly given extended deployments and restricted shore leave. Respondents frequently highlighted that COVID-19 protocols should apply equally across the organization. The frustration with inconsistent application of protocols is exemplified by one mariner's observation: "I think it's crazy that we were locked down, not allowed to go ashore, yet contractors were allowed to come and go with just a temperature check and a questionnaire. We were exposed to the contractors every day, yet we could not go ashore." This inconsistency in COVID-19 protocol application causes confusion and stress, mirroring challenges documented in other essential worker populations during the pandemic.<sup>27</sup> The preference for systematic, organizational-level solutions aligns with healthcare industry research showing that comprehensive organizational interventions to reduce occupational stress are more effective than individual-level interventions.<sup>28</sup> Beyond specific control measures, mariners called for greater recognition of their essential worker status through both tangible support (increased pay, hazard compensation) and intangible acknowledgment of their sacrifices during the crisis. These findings suggest future emergency protocols should integrate both practical safety measures and mechanisms to address workforce morale and wellbeing through appropriate compensation and recognition.

This study's qualitative methodology provided several strengths for understanding mariners' experiences during the pandemic. The open-ended response format enabled insights into lived

experiences and uncovered nuanced perspectives that more structured surveys are not designed to capture. The large sample size for a qualitative study (n=478) and diverse representation across vessel types and maritime positions enhanced the richness of the collected data. The inductive coding approach permitted the discovery of previously unidentified stressors and coping mechanisms informed directly by data specific to the maritime environment, while the methodology was particularly valuable for exploring this relatively understudied population within occupational health research. Additionally, the qualitative approach captured rich descriptions of workplace transactions and personal narratives that added crucial depth to understanding how pandemic policies affected different demographic groups, particularly regarding gender and age variations in stress responses. The open-ended format also empowered mariners to express their concerns in their own words, providing an authentic platform for feedback about their experiences, which is especially valuable for understanding perspectives of underrepresented groups within the maritime workforce.

This study has limitations that warrant consideration. The responses were gathered in response to a single open-ended question in the context of a larger survey of stress and mental health among U.S. mariners; this context likely influenced the responses received to the question used in this analysis. The qualitative methodology, while providing detailed insights into mariners' experiences, limits generalizability to the broader maritime population. The data collection timing during an active pandemic may have influenced response patterns, potentially emphasizing acute rather than chronic industry challenges. The self-selected nature of survey participation could have introduced response bias, particularly among those most impacted by pandemic-related changes. Finally, the coding was done using human coders; interrater

reliability was high at 90 percent on average, but there is a risk of subjectivity in applying codes, thus imparting bias on the results.

This study revealed the occupational challenges faced by U.S. mariners during the COVID-19 pandemic, with inadequate organizational support emerging as the most common code overall.

The analysis identified key stressors including inability to disembark, extended voyages, and ineffective controls, with notable variations across gender and age groups. Female mariners reported higher concerns about economic uncertainty, reflecting broader pandemic-driven gender disparities in employment security, while older mariners (55+) showed greater attention to both effective and lacking COVID-19 controls.

The findings have several implications for maritime industry practices and policy development. They demonstrate the need for enhanced communication infrastructure between shoreside management and vessel crews, especially during crisis situations. Additionally, they highlight the importance of implementing standardized, evidence-based protocols for vessel access and crew changes that effectively balance operational requirements with crew welfare. The variation in reported stressors across gender and age groups also suggests the need for targeted approaches in future emergency response protocols. The unique experiences reported by women and younger mariners demonstrates the vital need to create a supportive work environment in order to recruit and retain these populations in the maritime workforce.

## Chapter 2 Tables and Figures

**Table 1.** Characteristics of Respondents

|                 |                                            | <b>n</b> | <b>%</b> |
|-----------------|--------------------------------------------|----------|----------|
| Age (years)     | 18-34                                      | 124      | 25.9     |
|                 | 35-44                                      | 89       | 18.6     |
|                 | 45-54                                      | 82       | 17.2     |
|                 | 55+                                        | 160      | 33.5     |
|                 | Did Not Respond                            | 23       | 4.8      |
| Gender          | Male                                       | 391      | 81.8     |
|                 | Female                                     | 55       | 11.5     |
|                 | Other                                      | 26       | 5.4      |
|                 | Did Not Respond                            | 6        | 1.3      |
| Credential      | Cadet/Pilot                                | 18       | 3.7      |
|                 | Licensed                                   | 332      | 69.6     |
|                 | Unlicensed                                 | 86       | 18.0     |
|                 | Other                                      | 41       | 8.6      |
|                 | Did Not Respond                            | 1        | <1       |
| Maritime Vessel | Oceangoing cargo vessels                   | 112      | 23.4     |
|                 | Inland and coastal cargo vessels/workboats | 147      | 30.8     |
|                 | Passenger vessels                          | 28       | 5.9      |
|                 | Government/public vessels                  | 151      | 31.6     |
|                 | Other vessels                              | 39       | 8.2      |
|                 | Did Not Respond                            | 1        | <1       |

**Table 2.** Overall frequency and substrata frequency of assigned codes among gender and age groups

|                                                    |                                                                                              | Overall<br>(n=840*) | Gender          |                   | Age              |                  |                |
|----------------------------------------------------|----------------------------------------------------------------------------------------------|---------------------|-----------------|-------------------|------------------|------------------|----------------|
|                                                    |                                                                                              |                     | Male<br>(n=682) | Female<br>(n=106) | 18-34<br>(n=228) | 35-54<br>(n=321) | 55+<br>(n=253) |
| Code                                               | Illustrative Quote                                                                           | n (%)               | n (%)           | n (%)             | n (%)            | n (%)            | n (%)          |
| <b>STRESSORS</b>                                   |                                                                                              |                     |                 |                   |                  |                  |                |
| General Inadequate support from shoreside          | “Decision making efforts are placed directly on the Mariner, with no support from shore”     | 103 (12.3)          | 85 (12.5)       | 13 (12.3)         | 34 (14.9)        | 42 (13.1)        | 22 (8.7)       |
| Inability to deboard relates to stress             | “Being trapped on a vessel is more stressful than the fear of getting COVID-19”              | 86 (10.2)           | 64 (9.4)        | 15 (14.2)         | 35 (15.4)        | 30 (9.3)         | 15 (5.9)       |
| Ineffective or Unnecessary Controls                | “COVID rule enforcement rely on individuals’ willingness to observe and report themselves”   | 82 (9.8)            | 67 (9.8)        | 8 (7.5)           | 19 (8.3)         | 33 (10.3)        | 25 (9.9)       |
| Unjust application of covid policies and practices | “Being restricted to the ship while contractors come and go is wrong”                        | 53 (6.3)            | 45 (6.6)        | 4 (3.8)           | 11 (4.8)         | 21 (6.5)         | 19 (7.5)       |
| Increased stress due to work changes with COVID-19 | “The administrative burden and safety protocols increased the workload”                      | 53 (6.3)            | 41 (6.0)        | 8 (7.5)           | 13 (5.7)         | 28 (8.7)         | 11 (4.3)       |
| Long/extended voyages relate to stress             | “I was on a ship from early March until mid-August... most miserable experience of my life!” | 51 (6.1)            | 43 (6.3)        | 7 (6.6)           | 20 (8.8)         | 21 (6.5)         | 7 (2.8)        |
| Economic Uncertainty due to inadequate support     | “We received 30% pay cuts with no additional government benefits”                            | 45 (5.4)            | 33 (4.8)        | 8 (7.5)           | 12 (5.3)         | 16 (5.0)         | 15 (5.9)       |

|                                                        |                                                                                                |          |          |            |          |          |          |
|--------------------------------------------------------|------------------------------------------------------------------------------------------------|----------|----------|------------|----------|----------|----------|
| Needed COVID controls are lacking                      | "I couldn't even get sanitizer or wipes"                                                       | 42 (5.0) | 36 (5.3) | 4 (3.8)    | 11 (4.8) | 14 (4.4) | 16 (6.3) |
| Stress due to worries about family                     | "Most of the added stress is worrying about my family at home."                                | 38 (4.5) | 33 (4.8) | 3 (2.8)    | 11 (4.8) | 17 (5.3) | 9 (3.6)  |
| Political Climate influences experience sailing/stress | "This was never about public health, it's about control."                                      | 37 (4.4) | 29 (4.3) | 3 (2.8)    | 8 (3.5)  | 10 (3.1) | 14 (5.5) |
| PPE** rules cause increased stress                     | "Wearing masks creates issues with understanding helm commands."                               | 13 (1.5) | 10 (1.5) | 3 (2.8)    | 3 (1.3)  | 5 (1.6)  | 5 (2.0)  |
| Things off vessel causing stress                       | "While ashore, I have been affected by seeing how people are out in public. It is sad."        | 9 (1.1)  | 9 (1.3)  | NA*** (NA) | 3 (1.3)  | 5 (1.6)  | 1 (0.4)  |
| SOLUTIONS                                              |                                                                                                |          |          |            |          |          |          |
| Effective Existing Controls                            | "Masks are required, hand sanitizer is available, vessels kept clean, and physical distancing" | 30 (3.6) | 26 (3.8) | 4 (3.8)    | 5 (2.2)  | 10 (3.1) | 15 (5.9) |
| Quarantine rules                                       | "Shipboard restriction for months, 2-week quarantine in poor hotel."                           | 30 (3.6) | 22 (3.2) | 4 (3.8)    | 11 (4.8) | 11 (3.4) | 6 (2.4)  |
| Vaccines                                               | "Can't wait until I can get the vaccine and hopeful for everyone else."                        | 29 (3.5) | 25 (3.7) | 4 (3.8)    | 7 (3.1)  | 10 (3.1) | 12 (4.7) |
| Inadequate support influences intent to Leave          | "I will never work for MSC contract again due to COVID being used to deny me of human rights"  | 17 (2.0) | 14 (2.1) | 3 (2.8)    | 4 (1.8)  | 8 (2.5)  | 5 (2.0)  |
| Increased Compensation                                 | "Crew should be compensated fairly during this pandemic."                                      | 15 (1.8) | 12 (1.8) | 3 (2.8)    | 4 (1.8)  | 6 (1.9)  | 5 (2.0)  |

|                              |                                                                                               |          |          |         |         |         |         |
|------------------------------|-----------------------------------------------------------------------------------------------|----------|----------|---------|---------|---------|---------|
| Administrative controls      | “Would like to see company provide for care if COVID is contracted on board.”                 | 14 (1.7) | 12 (1.8) | NA (NA) | 4 (1.8) | 3 (0.9) | 6 (2.4) |
| Increased worker flexibility | “Admin should be more understanding on our needs, like choice of which ship we go on.”        | 14 (1.7) | 13 (1.9) | 1 (0.9) | 3 (1.3) | 5 (1.6) | 6 (2.4) |
| Testing                      | “Rapid testing prior to boarding could have been the solution to this pandemic.”              | 12 (1.4) | 7 (1.0)  | 4 (3.8) | 2 (0.9) | 2 (0.6) | 8 (3.2) |
| Public Recognition/Education | “Mariners should be considered critical workers and placed high on the list for vaccines.”    | 10 (1.2) | 9 (1.3)  | 1 (0.9) | 3 (1.3) | 3 (0.9) | 4 (1.6) |
| PPE                          | “There should be a ready supply of PPE at the embarkation point for anyone needing it.”       | 4 (0.5)  | 3 (0.4)  | 1 (0.9) | NA (NA) | NA (NA) | 3 (1.2) |
| Engineering Controls         | “There are vessels with temporary air-handling equipment that exchanges air every 3 minutes.” | 3 (0.4)  | 2 (0.3)  | 1 (0.9) | NA (NA) | NA (NA) | 3 (1.2) |

\*Numbers are higher than the total number of responses coded (n=478) because many responses had more than one code applied;

\*\*Personal Protective Equipment (PPE); \*\*\*Not applicable (NA)

**Figure 1.** Most frequently assigned codes across age and gender groups

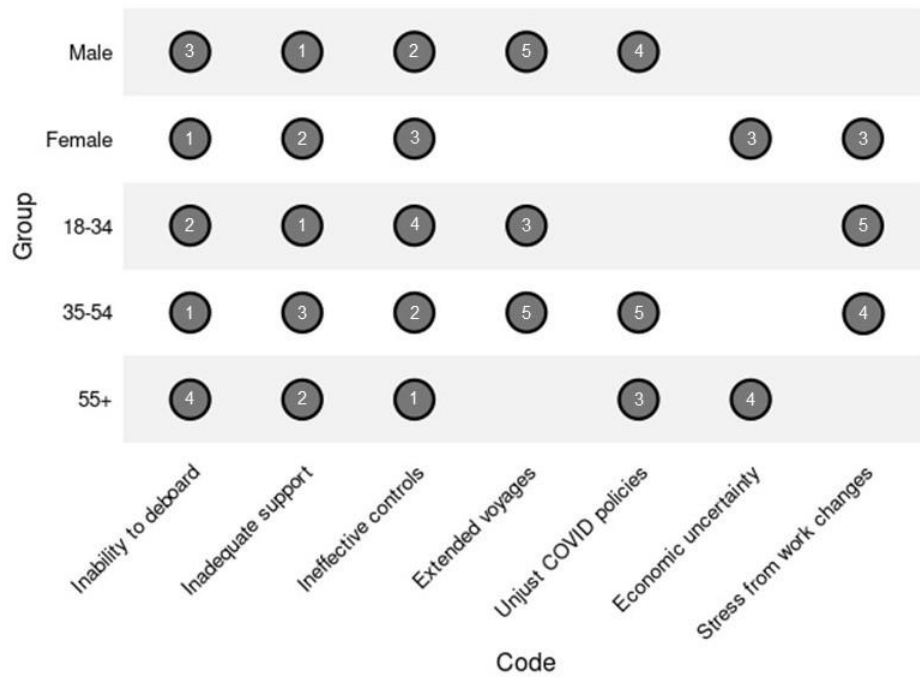


Figure 1. The above figure depicts the top 5 codes for gender and age groups, with a circle indicating the code on the x-axis was in the top 5 codes for the group on the y-axis and the number within the circle corresponding to the code's rank within the group. Groups with more than 5 circles indicate that codes were ties for the fifth place for a group.

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## **Chapter 3. Interpersonal Work Environment, Mental Health, and Intent to Leave Among U.S. Mariners: An Exploration with Latent Profile Analysis**

### **3.1 Introduction**

Mental disorders are the leading cause of disability worldwide, with a substantial burden among working-age adults.<sup>1,2</sup> Adverse psychosocial working conditions are among the most consistently identified occupational contributors to depression and anxiety, supported by meta-analytic evidence spanning decades of prospective research.<sup>3,4</sup> These relationships have also been observed in the maritime industry.<sup>5</sup> In U.S. contexts, “mariner” is the common term for workers across deep-sea, coastal, and inland vessels that transport goods or people, while the international maritime literature more commonly refers to this workforce as “seafarers”.<sup>6</sup> For many mariners, work involves living and working aboard vessels for extended periods, contending with family separation, physical confinement, and challenges accessing mental health care.<sup>5,7</sup> Mental health has been identified as a common concern among the global seafaring population; a multinational seafarer survey found one in four respondents screened positive for depression and one in five reported suicidal ideation in the prior two weeks.<sup>8</sup> Among U.S. mariners surveyed during the COVID-19 pandemic, 20.4% screened positive for depression and 16.9% for anxiety.<sup>9</sup> At the same time, worker retention has become an industry concern: the 2023 officer supply deficit reached approximately 9% of the global pool, the highest level in 17 years of tracking, with similar shortfalls projected through 2028.<sup>10</sup>

The psychosocial work environment is defined as the aspects of work that pertain to interpersonal and social interactions and influence worker behavior and health.<sup>11</sup> Interpersonal dimensions of the psychosocial work environment include exposure to workplace bullying and harassment, quality of peer and supervisor relationships, recognition, and social support on the

job.<sup>12</sup> Under the Job Demands-Resources (JD-R) model, a cornerstone of occupational health psychology offering a framework with which to assess organizational and job characteristics alongside worker health and wellbeing, workplace bullying and harassment function as job demands that deplete psychological resources, while coworker support functions as a job resource that buffers strain.<sup>13,14</sup> A meta-analysis of 66 independent samples found that exposure to workplace bullying is associated with adverse mental and physical health, reduced job satisfaction, and increased intent to leave.<sup>15</sup> The interpersonal dimensions of the psychosocial work environment have received comparatively little systematic attention in maritime research, which has more often focused on physical exposures, fatigue, and schedule demands.<sup>5</sup> To date, a systematic characterization of the interpersonal work environment experienced by U.S. mariners has not been undertaken.

Job satisfaction is a plausible mechanism linking the interpersonal work environment to mental health and retention. A meta-analysis of 485 studies reported that job satisfaction was more strongly associated with mental health outcomes than with physical health outcomes.<sup>11</sup>

Prospective evidence from a 1-year follow-up of Japanese civil servants showed that baseline job satisfaction was associated with the development of depressive symptoms at follow-up after adjustment for baseline depression, while persistence of symptoms was associated with low job control and high job demands.<sup>12</sup> Among international maritime workers, job satisfaction has been positively associated with employee retention.<sup>16,17</sup> Another study of seafarers working for a large shipping company found instrumental support as a central predictor of seafarer job satisfaction and concluded that a supportive, equal, and just work environment is a cornerstone of seafarer psychosocial wellbeing.<sup>18</sup> Most prior maritime work has examined job satisfaction as an outcome

or covariate rather than as the pathway through which interpersonal conditions may operate on mental health and retention.

Existing research on the psychosocial work environment and mental health has relied predominantly on variable-centered methods (eg, regression) which estimate associations between individual variables averaged across the full sample and examine each dimension of the work environment as a separate predictor.<sup>19–21</sup> Recent examples include a study of Black Sea seafarers,<sup>22</sup> which used Gaussian graphical modeling to map the network of associations among mental health symptoms and working conditions. Such approaches characterize the relationship of variables across the whole population but do not capture the joint configuration of conditions within individual mariners. Latent profile analysis (LPA), a person-centered Gaussian mixture approach, identifies subgroups of individuals with similar multivariate profiles and reveals configurations that variable-centered approaches obscure.<sup>23,24</sup> One study applied LPA to a national Canadian psychosocial work environment survey and found profile membership more strongly associated with burnout and stress than any single work stressor.<sup>20</sup> Configurations of experiences assessed together may be more informative than each predictor on its own.

Identifying configurations of the interpersonal environment is especially useful in maritime where living and working onboard can vary substantially between vessels and individual mariners. Systematic reviews of seafarer mental health have identified social isolation and loneliness as primary mental health stressors,<sup>5,7</sup> and onboard peer support was identified as a meaningful protective factor during the COVID-19 pandemic.<sup>25</sup> The absence of positive interpersonal connection therefore represents a distinct source of risk for mariners that may occur with, or independently of, exposure to bullying and harassment, warranting analytic methods that can characterize the onboard interpersonal landscape mariners work within.

Research has been called for to identify mental health challenges and intervention priorities specific to the U.S. maritime workforce.<sup>26</sup> Studies of U.S. mariners have reported high prevalence of depression and anxiety symptoms alongside a need for wider-distribution follow-up examining occupational risks.<sup>6,9</sup> The maritime mental health literature has been dominated by studies of international seafarers in Europe and Asia, and findings may not generalize to U.S. domestic operations given differences in flag-state regulation, labor organization, and workforce composition.<sup>5</sup> In response, the primary aims of the present study were to (1) identify how characteristics of the shipboard interpersonal work environment form distinct profiles of experience among U.S. mariners and (2) examine associations between these profiles, mental health, and intent to leave the maritime industry. In estimating these relationships, the study provides evidence to inform organizational and industry-level interventions to improve the onboard experiences of U.S. maritime workers.

### **3.2 Methods**

#### Analytic Strategy

The analytic strategy of this study is guided by a conceptual model (Figure 1) constructed per the principles of Hernán and Robins.<sup>27</sup> Under JD-R theory, adverse interpersonal work environments activate the health impairment process through depleted resources, of which job satisfaction is a proximal indicator.<sup>28</sup> Prospective research positions job dissatisfaction as a predictor of depression,<sup>12</sup> and evidence from international seafarer samples indicates that mental health symptoms are associated with intent to leave the maritime industry.<sup>19</sup> The conceptual model represents a proposed causal structure that cannot be verified by the cross-sectional design of this study. All associations are reported as observational estimates consistent with the proposed model but do not meet criteria for causal inference.

### Study design and participants

The 2025 Mariner Mental Health and Wellbeing Survey was a cross-sectional, anonymous, web-based survey administered via REDCap<sup>29</sup> by the University of Washington. The survey was open from June to September 2025 and was distributed through maritime unions, industry associations, maritime academies, and social media channels targeting U.S. mariners. Eligible participants were credentialed U.S. citizen or permanent resident mariners who currently or formerly sailed on U.S.-flagged vessels. The study was reviewed and approved by the University of Washington Institutional Review Board (exempt; Study 00022348; approved 02/06/2025).

### Measures

Three composite indicators were constructed to characterize the shipboard interpersonal work environment. (1) Negative interpersonal experiences: a six-item subset adapted from the Short Negative Acts Questionnaire (SNAQ),<sup>30</sup> capturing the frequency of personally experienced gossip, insults, repeated criticism, being shouted at, being ignored/excluded, and persistent criticism over the past 12 months. Items were scored 0 (never) to 3 (weekly or more often) and summed to a composite score (range 0–18;  $\alpha = 0.88$ , 95% CI: 0.86–0.90). Respondents missing more than one of six items were excluded; those missing exactly one item were prorated by multiplying the observed sum by 6/5. (2) Positive interpersonal experiences: four items assessing personally experienced celebration by shipmates, invitations to socialize, praise from shipmates or the captain, and organizational recognition, using the same 0–3 frequency scale (range 0–12;  $\alpha = 0.62$ , 95% CI: 0.56–0.67); a minimum of three of four items was required, with single-item missingness prorated by the same method. (3) Onboard social support: a single item (“If I am feeling stressed or sad, there is usually someone on the vessel I can talk to”), rated on a 1–4 agree scale (1 = strongly disagree, 4 = strongly agree). All three indicators were standardized (z-

scored) prior to LPA estimation, placing them on a common scale so that no single indicator carried more weight when estimating the profiles.

Depression was assessed using the Patient Health Questionnaire-2 (PHQ-2),<sup>31</sup> comprising two items on frequency of low interest and depressed mood over the past two weeks (scored 0–3 each; range 0–6). A score of  $\geq 3$  was used as the positive screen threshold (indicating major depressive disorder is likely).<sup>31</sup> Anxiety was assessed using the Generalized Anxiety Disorder-2 (GAD-2),<sup>32</sup> comprising two items on feeling nervous and inability to control worrying (same scoring;  $\geq 3$  threshold indicating generalized anxiety disorder is likely).<sup>32</sup> Perceived stress was assessed using the abbreviated Perceived Stress Scale (PSS-4),<sup>33,34</sup> comprising four items to assess stress over the past month. In contrast to the original scale, item one was framed positively (“You were able to control the important things in your life”) and was reverse scored. Scoring for the other items was consistent with standard PSS-4 usage protocols. Items summed to a total score (range 0–16; higher = greater perceived stress).

Three items adapted from Spector’s 36-item Job Satisfaction Survey (JSS)<sup>35</sup> assessed satisfaction with coworkers (“I like the people I work with”), intrinsic work tasks (“I like doing the things I do at work”), and recovery time when sailing (“I get enough time to relax and recharge when on the vessel”), each rated 1–4 (strongly disagree to strongly agree) and summed to a composite score (JSS-3; range 3–12;  $\alpha = 0.65$ , 95% CI: 0.58–0.71). Higher scores indicate greater job satisfaction. Statistics on scale reliability are reported in Table S1.

A single item assessed intent to leave (ITL) the maritime industry (“How likely are you to look for a job outside of the maritime industry in the next year?”), rated on a 0–10 scale (0 = very unlikely, 10 = very likely).

Gender was coded as a binary variable (male/female). The survey item assessed gender identity with response options for Male, Female, Other, and Prefer not to answer. Four respondents identifying as “other,” six selecting “prefer not to answer,” or with missing gender responses were excluded from the analytic sample. Collapsing the “Other” respondents into the female category was rejected on the grounds that it would override the identity reported by these individuals (see Table S2 for Male/Non-Male specification model results); separate estimation was not feasible given the subgroup size. Age was collapsed into four groups: 18–34, 35–44, 45–54, and 55+. Maritime career length was collapsed into three stages: Early (<5 years), Mid (5–19 years), and Late (20+ years). Self-rated physical health was ascertained with one item on a 5-point Likert scale from excellent (1) to poor (5) and dichotomized as fair/poor (>3) versus good or better ( $\leq 3$ ). Sleep duration was assessed as self-reported average hours of sleep per 24-hour period when sailing (continuous). Exercise frequency was assessed with a single item (“I engage in physical exercise regularly”), scored 0 (never) to 3 (always) and treated as continuous. Gender-based violence and harassment (GBVH) was not included as a covariate in the primary models due to sample size constraints with the GBVH item; sensitivity analysis was performed to ensure stability of model results with/without GBVH as a covariate.

#### Sample definition and missing data

A two-stage analytic sample was used. The LPA was fit on all respondents with complete data on the three indicators ( $N = 422$ ) to preserve the profile structure estimated from the broadest available data. Profile assignments were then carried forward to a regression sample ( $N = 346$ ) defined by complete data on all covariates and outcomes. Only respondents with complete data for all model covariates were included in the regression analyses. Respondents excluded due to missingness were significantly more likely to be non-White (34.2% vs. 10.1%) and to report

higher intent to leave (mean 5.02 vs. 3.82) than included respondents (Table S3); mental health outcomes and SNAQ scores did not differ significantly.

### Latent profile analysis

LPA was conducted to identify discrete subgroups of respondents with similar patterns across the three interpersonal work environment indicators (negative interpersonal experiences, positive interpersonal experiences, social support). Gaussian mixture models were estimated in the ‘mclust’ package (v6.1.1)<sup>36</sup> in R, with 10 random starts per solution (seed = 42). Solutions K = 2 through K = 4 were estimated across four diagonal covariance structures (EEI, VEI, EVI, VVI), which differ in whether within-profile variances are constrained to be equal or allowed to vary across profiles and across indicators: EEI fixes within-profile variances to be equal for both profile and indicator, VEI allows variances to differ by profile while constraining the shape across indicators, EVI allows variances to differ by indicator but constrains profile magnitude, and VVI allows both to vary freely.<sup>36</sup> Evaluating across these structures is standard practice in applied LPA because the appropriate degree of constraint cannot generally be specified in advance.<sup>24</sup> Solutions were compared using the Bayesian Information Criterion (BIC), sample-size adjusted BIC (saBIC), entropy ( $\geq 0.80$  indicates good classification accuracy),<sup>37</sup> average posterior probability (AvePP), and substantive interpretability, with a minimum class size of  $\geq 40$  required for stable regression estimation. Fit statistics for all solutions are presented in Table S4. Individuals were assigned to the profile to which they had the highest probability of belonging, also called modal assignment.<sup>24</sup>

### Regression analyses

The conceptual model guided variable selection and the ordering of regression specifications. Gender, age, career stage, physical health, sleep, and exercise are treated as upstream confounders; interpersonal work environment profile as the primary exposure; job satisfaction and mental health as proposed mediators; and intent to leave as the distal outcome.

Multivariable regression models were fit for each of three mental health outcomes (PHQ-2 positive screen, GAD-2 positive screen: logistic regression; PSS-4 score: linear regression) with interpersonal work environment profile as the primary predictor (Supportive as reference category). Two specifications were estimated for each outcome: Model 1 (profile + confounders) excluded job satisfaction and estimated the total association of profile with mental health; Model 2 added job satisfaction. Attenuation of profile coefficients from Model 1 to Model 2 quantified the share of the total association consistent with a satisfaction pathway. Effect size was characterized using Nagelkerke  $R^2$  (logistic models) and adjusted  $R^2$  (linear model).

For intent to leave, four sequential model specifications were estimated using linear regression: Model A (profile + confounders only; total association); Model B (+ job satisfaction); Model C (+ PHQ-2, GAD-2, and PSS-4); Model D (+ both sets of mediators). Attenuation of profile coefficients across specifications characterized the relative contribution of each pathway. The association between profile and job satisfaction was estimated in a separate model and is reported in the supplement (Table S5). Attenuation percentages were calculated as the percent change in the profile coefficient between model specifications, computed on the log-odds scale for logistic outcomes and the raw coefficient scale for linear outcomes. These are reported as descriptive summaries of coefficient change across specifications and do not constitute formal mediation estimates.

As sensitivity analyses, the GBVH item was added to each primary model to evaluate whether profile coefficients were confounded by GBVH exposure (Table S6). All analyses were conducted in R v4.5.2.<sup>38</sup>

### **3.3 Results**

#### Latent Profile Analysis Specifications and Profile Descriptions

LPA was conducted on N = 422 respondents with complete data on the three interpersonal work environment indicators. The covariance structure VEI (Diagonal Orientation, Variable Volume, Equal Shape) K = 3 solution was selected as the primary solution based on adequate entropy (0.794), high within-profile average posterior probabilities (0.83-0.96), substantively interpretable profiles, competitive BIC relative to alternatives, and a minimum class size of n = 72.

Demographics and characteristics of the three identified profiles and the full data set are summarized in Table 1 and Figure 2. The Supportive profile (n = 222 in the regression sample, 64.2%) was characterized by low SNAQ scores (mean = 3.25, SD = 2.77), high positive experiences (mean = 5.47, SD = 1.95), and adequate social support (mean = 2.64, SD = 0.64). The Isolating profile (n = 67, 19.4%) was characterized by SNAQ scores comparable to the sample average (mean = 4.87, SD = 2.14, vs sample mean = 5.19) alongside reduced social support (mean = 1.27, SD = 0.45) and low positive experiences (mean = 2.57, SD = 1.48). The Hostile profile (n = 57, 16.5%) was defined by elevated SNAQ scores (mean = 13.12, SD = 2.49, approximately 1.8 standard deviations above the sample mean), minimal social support (mean = 1.28, SD = 0.53), and low positive experiences (mean = 3.61, SD = 2.12). These labels describe the interpersonal work environment to which mariners were exposed, not the mariners

themselves; the Hostile profile denotes an environment marked by frequent negative acts and low support, not hostility on the part of those assigned to it.

Mean posterior probability of modal assignment was 0.907, and 71.3% of respondents were assigned with posterior probability  $>0.90$ . Within-profile average posterior probabilities were 0.919 (Supportive), 0.826 (Isolating), and 0.961 (Hostile), indicating adequate reliability. Full posterior probabilities are reported in Table S7.

Age or exercise did not differ significantly between profiles (Table 1). Women were overrepresented in the Hostile profile (29.8%) relative to the Isolating (6.0%) and Supportive (10.8%) profiles, though men still constituted the majority of all profiles. Experience of GBVH was significantly more prevalent in the Hostile profile (36.8%) than the Isolating (10.4%) or Supportive (11.3%) profiles, reported here descriptively but was not included in the regression. Job satisfaction decreased across profiles, with means of 9.09, 7.55, and 6.88 in the Supportive, Isolating, and Hostile profiles, respectively. Early career mariners were more likely to be in the Hostile profile, fair or poor self-reported physical health was more common in the Isolating profile, and mean sleep hours per 24-hour period were lower in both non-Supportive profiles. Intent to leave was significantly higher in the Isolating (mean = 4.67, SD = 3.52) and Hostile (mean = 4.79, SD = 3.92) profiles relative to Supportive (mean = 3.31, SD = 3.45).

Mental health outcomes also varied across the three profiles. PHQ-2 positive screen rates were 18.5%, 41.8%, and 63.2% in the Supportive, Isolating, and Hostile profiles, respectively. GAD-2 positive screen rates were 20.3%, 44.8%, and 59.6%. Mean PSS-4 scores were 4.49 (SD = 2.80), 6.91 (SD = 3.11), and 7.89 (SD = 2.87). All three between-profile differences were significant.

#### Multivariable Regression Models: Mental Health Outcomes

Model 1 results, which estimate the overall association between interpersonal work environment profile and mental health, are presented in Table 2. After adjustment for confounders, profile membership was significantly associated with all three outcomes. Isolating profile membership was associated with 2.77-fold higher odds of a positive depression screen (95% CI: 1.45–5.28) and 3.36-fold higher odds of a positive anxiety screen (95% CI: 1.79–6.32) relative to the Supportive profile, and with PSS-4 scores 1.94 points higher than the Supportive profile (95% CI: 1.20–2.68). Hostile profile membership was associated with 5.62-fold higher odds of depression (95% CI: 2.76–11.43), 4.81-fold higher odds of anxiety (95% CI: 2.38–9.72), and PSS-4 scores 2.57 points higher than the Supportive profile (95% CI: 1.75–3.40). Nagelkerke  $R^2$  was 0.278 for depression and 0.244 for anxiety; adjusted  $R^2$  for PSS-4 was 0.326.

Adding job satisfaction in Model 2 attenuated profile coefficients to differing degrees across profiles and outcomes (Table 2). For the Isolating profile, the coefficient for depression attenuated by 49.8% and was no longer significant (OR = 1.67, 95% CI: 0.83–3.34); the anxiety coefficient attenuated by 29.8% and remained significant (OR = 2.34, 95% CI: 1.20–4.57); the PSS-4 coefficient attenuated by 34.4% and remained significant ( $\beta$  = 1.27, 95% CI: 0.52–2.03). For the Hostile profile, coefficients attenuated by 37% to 44% but remained significant for all three outcomes (depression OR = 2.61, 95% CI: 1.17–5.80; anxiety OR = 2.70, 95% CI: 1.23–5.93; PSS-4  $\beta$  = 1.54, 95% CI: 0.67–2.42). In Model 2, job satisfaction had an independent and negative association with all three outcomes (OR = 0.64 for depression, 95% CI: 0.52–0.78; OR = 0.74 for anxiety, 95% CI: 0.62–0.89;  $\beta$  = –0.51 for PSS-4, 95% CI: –0.69 to –0.32). Profile membership was also significantly associated with job satisfaction itself; the full coefficients for mental health outcome models (Models 1 and 2) are reported in Table S8.

#### Multivariable Regression Models: Intent to Leave Outcome

Results of four sequential intent-to-leave models are presented in Table 3. In Model A, Isolating profile membership was significantly associated with higher intent to leave ( $\beta = 1.16$ , 95% CI: 0.16–2.16); the Hostile profile coefficient was of similar magnitude and was marginally significant ( $\beta = 1.10$ , 95% CI: –0.01–2.20). Adjusted  $R^2$  was 0.040.

Adding job satisfaction (Model B) attenuated the Isolating coefficient by 63.4% ( $\beta = 0.42$ , 95% CI: –0.60–1.45) and the Hostile coefficient by 103.6% ( $\beta = -0.04$ , 95% CI: –1.23–1.16); neither profile coefficient remained significant. Job satisfaction was strongly and independently associated with intent to leave ( $\beta = -0.56$ , 95% CI: –0.81 to –0.31). Adding mental health outcomes only (Model C) attenuated the Isolating coefficient by 59.2% and the Hostile coefficient by 97.9%. A positive depression screen and higher PSS-4 scores were significantly associated with intent to leave in this model (PHQ-2:  $\beta = 1.59$ , 95% CI: 0.59–2.59; PSS-4:  $\beta = 0.16$ , 95% CI: 0.01–0.32). In Model D, adding both job satisfaction and mental health variables, neither the Isolating nor Hostile profile coefficients remained significant (adjusted  $R^2 = 0.126$ ), while job satisfaction and positive depression screen retained their independently significant associations.

### Sensitivity analyses

Adding the GBVH item to the primary regression models did not change profile coefficients by more than 5%, and GBVH coefficients were non-significant across all four outcomes (Table S6), indicating that profile associations were not confounded by GBVH exposure.

## **3.4 Discussion**

Three profiles of the shipboard interpersonal work environment were identified among U.S. mariners in this study: Supportive, Isolating, and Hostile. Both Isolating and Hostile profiles

were associated with elevated depression, anxiety, perceived stress, and intent to leave the maritime industry, with differential patterns of attenuation after adjustment for job satisfaction and mental health.

The profile structure is supported by and extends LPA evidence from general working populations. Using the Copenhagen Psychosocial Questionnaire, a study identified four psychosocial work environment profiles in a national Canadian sample that were uniformly ordered, such that workers scoring favorably on one dimension tended to score favorably across all dimensions.<sup>20</sup> The Isolating profile observed here departs from that pattern: mariners in this profile reported only negative interpersonal experiences comparable to the sample average and to the Supportive profile, alongside low social support and few positive interpersonal experiences. This configuration is defined by social disconnection rather than bullying or harassment, consistent with descriptions of the shipboard environment as one in which mariners live and work alongside colleagues yet can lack supportive interpersonal relationships over months-long contracts.<sup>57</sup> LPA identifies configurations across all three interpersonal dimensions simultaneously, capturing combinations of experiences that variable-centered methods like regression do not.

Positive depression screens were higher in the Isolating (41.8%) and Hostile (63.2%) profiles than the 20.4% rate reported among U.S. mariners surveyed during the COVID-19 pandemic,<sup>9</sup> while the Supportive profile rate (18.5%) fell below that benchmark. The significant variance in mental health outcomes across profiles is consistent with meta-analytic evidence linking workplace bullying to depression and anxiety,<sup>15</sup> and with findings from international seafarer samples in which social stressors were among the stressor types most strongly associated with mental health problems.<sup>19</sup>

The differential attenuation of profile coefficients after adding job satisfaction suggests the Isolating and Hostile profiles relate to mental health in different ways. For the Isolating profile, job satisfaction attenuated roughly half of the total association with depression and reduced the coefficient to non-significance, while the Hostile profile attenuated to a similar degree but retained significance. Both profiles were associated with lower job satisfaction in supplementary regression models (Table S5). Meta-analytic evidence reports coworker support is positively associated with job satisfaction, and coworker antagonism is negatively associated with job satisfaction.<sup>39</sup> Importantly, both lack of social support<sup>40</sup> and bullying<sup>41</sup> have been identified as risk factors for poor mental health in the general population. The relationships observed in this study call for longitudinal research to clarify the temporal and directional relationships between interpersonal exposures, job satisfaction, and mental health.

Profile associations with intent to leave were accounted for by low job satisfaction and depression in sequential models, identifying these as proximal correlates of attrition risk. The continued significance of job satisfaction and depression in the fully adjusted model, alongside attenuation of both profile coefficients to nonsignificance, aligns with prior evidence linking low job satisfaction to turnover intention among seafarers<sup>42,8</sup> and with broader evidence that anxiety and depression are associated with intent to leave the profession.<sup>19</sup> Given the persistent shortage of officers,<sup>10</sup> improving shipboard interpersonal conditions may represent an upstream intervention point with potential to improve job satisfaction, mental health, and retention.

Women were overrepresented in the Hostile profile relative to their share of the analytic sample, a pattern is consistent with disproportionate exposure to hostile interpersonal conditions while still being the gender minority across all interpersonal profiles. A recent study of French seafarers found women were about twice as likely as men to report verbal aggression at work,

and about twice as many women (65.5% vs. 38.2%) reported sexual harassment over their working life compared to men.<sup>43</sup> Legal scholarship on global shipping identifies lack of shared cultural norms, confined living and working quarters, and rigid hierarchy as conditions that elevate risk of GBVH for women seafarers.<sup>44</sup> Dedicated investigation in larger samples with adequate power for subgroup analysis is warranted.

These findings have direct implications for occupational health intervention. The Total Worker Health framework posits that organizational work design and management practices exert a more direct influence on worker mental health than individual-level interventions.<sup>45,46</sup> Similarly, the psychosocial hierarchy of controls<sup>47</sup> provides a framework for prioritization: elimination of negative working conditions, substitution of safer policies, redesign of the working environment, employee education, and encouragement of healthy practices. The two non-Supportive profiles identified in this study map onto different levels of that hierarchy. Hostile environments call for elimination and substitution: enforcement of anti-bullying and anti-harassment policies, conflict management procedures, and organizational accountability mechanisms.<sup>48,49</sup> International regulation is converging on this approach, with amendments that came into force in January 2026 to the IMO Standards of Training, Certification and Watchkeeping for Seafarers (STCW) Code establishing mandatory training for the prevention of shipboard violence, bullying, harassment, and sexual harassment and assault.<sup>50</sup> Meanwhile, Isolating environments call for redesign rather than elimination, because the defining feature is the absence of a positive condition rather than the presence of a harmful one. A systematic review of interventions targeting workplace social environments found consistent well-being improvements from programs that introduced shared activities into workgroups, with effects most reliable when interventions had external facilitation and multiple components.<sup>51</sup> Structured peer support or

mentorship programs, recognition practices from peers and management, and trust- and empathy-building exercises, such as role reversal, are additional leverage points for increasing positive interpersonal experiences.<sup>52</sup> Individual-level interventions may complement these measures but cannot substitute for them.

### **3.5 Strengths and Limitations**

To our knowledge, this is the first study to apply latent profile analysis to the shipboard interpersonal work environment and among the first to examine the associations of interpersonal exposures with mental health outcomes and intent to leave among U.S. mariners. This analysis provides insights specific to the U.S. maritime context, while complementing the international evidence base. The profile structure identified here extends previous LPA application in general working populations<sup>20</sup> to U.S. mariners, providing a systematic characterization of the interpersonal environments specific to this profession.

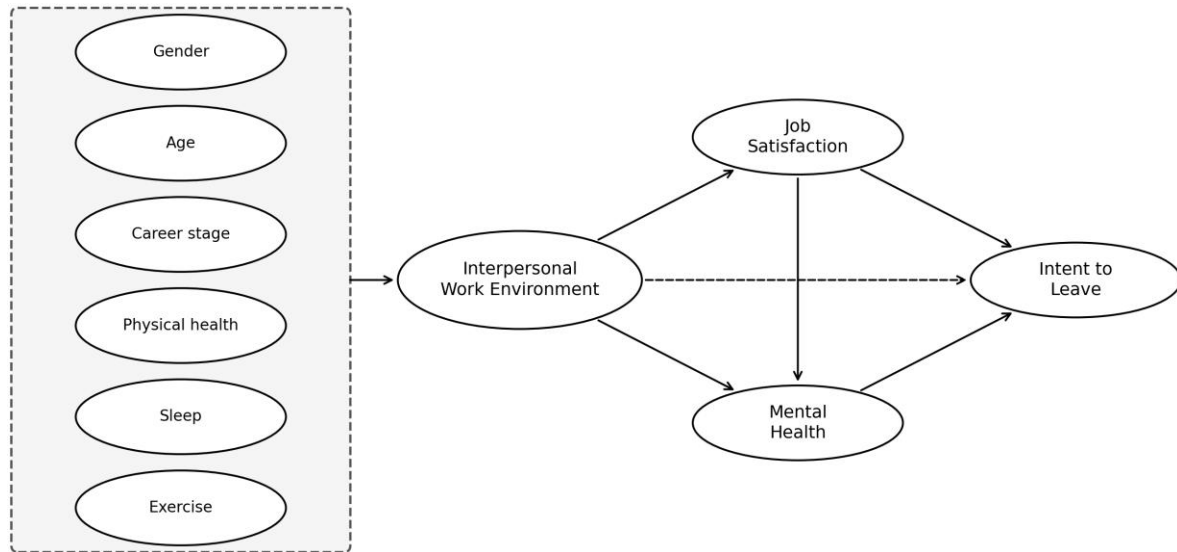
Several limitations should be noted. All measures were self-reported and subject to reporting bias. The sample was recruited through convenience channels, and volunteers may differ systematically from non-respondents in ways that cannot be assessed, limiting generalizability to the broader U.S. mariner workforce. Respondents excluded due to missingness differed from included respondents on race/ethnicity, job satisfaction, and intent to leave (Table S3); findings should be interpreted with this in mind. Four respondents were also excluded who identified their gender identity as “Other” as the subgroup size could not support stable estimates. Gender-diverse mariners may face distinct workplace exposures, and the present study cannot speak to their experiences. Future U.S. mariner research should prioritize recruitment strategies that build samples large enough to characterize these workers directly.

### **3.6 Conclusions**

Among U.S. mariners in this study population, the shipboard interpersonal work environment clustered into three profiles (Supportive, Isolating, Hostile) that differed in mental health burden and intent to leave the maritime industry. Low job satisfaction and depression attenuated the profile association with intent to leave across for both non-Supportive profiles. These patterns suggest that the interpersonal environment in which U.S. mariners operate is a modifiable occupational exposure. The interpersonal work environment has consequences for mental health and workforce stability in a sector already strained by persistent officer shortfalls. Organizational interventions that address hostile conditions directly and that build conditions for positive social connection where it is absent are priorities for further research and practice.

## Chapter 3 Figures and Tables

**Figure 1.** Conceptual Model



*Figure 1.* Interpersonal work environment is positioned as the primary exposure, with job satisfaction and mental health as potential mediators and intent to leave as the distal outcome. Solid arrows represent evidence-supported paths, while the dashed arrow represents a distal, non-direct path. Gender, age, and career stage are modeled as confounders, while physical health, sleep, and exercise are additional covariates included in all models; their paths to potential mediators and the outcome are omitted for visual clarity.

**Figure 2.** Interpersonal work environment profiles and their associations with mental health outcomes and intent to leave the maritime industry

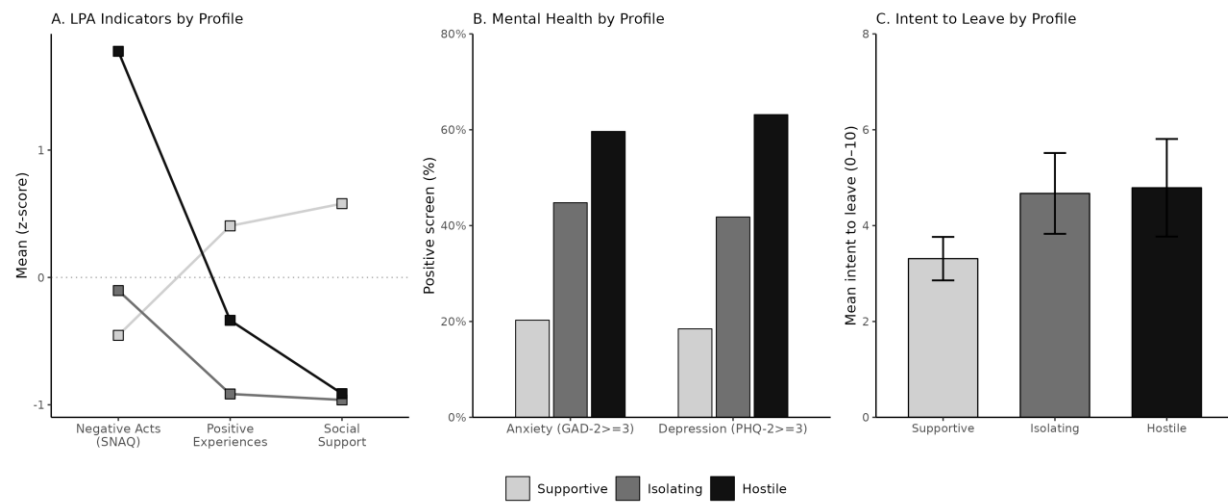


Figure 2. Panel A: LPA indicators by profile as z-scores; raw averages (not z-scores) appear in Table 1. Panel B: Positive screen rates for anxiety (GAD-2  $\geq 3$ ) and depression (PHQ-2  $\geq 3$ ). Panel C: Mean intent-to-leave score (0–10 scale) with 95% confidence intervals.

**Table 1.** Sample Characteristics and Interpersonal Work Environment Profiles

| Variable                         | Full<br>(N=346) | Supportive<br>(n=222) | Isolating<br>(n=67) | Hostile<br>(n=57) | <i>p</i> |
|----------------------------------|-----------------|-----------------------|---------------------|-------------------|----------|
| <b>LPA indicators</b>            |                 |                       |                     |                   |          |
| SNAQ, mean (SD)                  | 5.19 (4.43)     | 3.25 (2.77)           | 4.87 (2.14)         | 13.12 (2.49)      | <0.001   |
| Positive, mean (SD)              | 4.60 (2.24)     | 5.47 (1.95)           | 2.57 (1.48)         | 3.61 (2.12)       | <0.001   |
| Social support, mean (SD)        | 2.15 (0.88)     | 2.64 (0.64)           | 1.27 (0.45)         | 1.28 (0.53)       | <0.001   |
| <b>Sociodemographic</b>          |                 |                       |                     |                   |          |
| Female, n (%)                    | 45 (13.0)       | 24 (10.8)             | 4 (6.0)             | 17 (29.8)         | <0.001   |
| Age                              |                 |                       |                     |                   | 0.549    |
| 18–34, n (%)                     | 153 (44.2)      | 93 (41.9)             | 30 (44.8)           | 30 (52.6)         |          |
| 35–44, n (%)                     | 75 (21.7)       | 51 (23.0)             | 15 (22.4)           | 9 (15.8)          |          |
| 45–54, n (%)                     | 54 (15.6)       | 32 (14.4)             | 11 (16.4)           | 11 (19.3)         |          |
| 55+, n (%)                       | 64 (18.5)       | 46 (20.7)             | 11 (16.4)           | 7 (12.3)          |          |
| Career Length                    |                 |                       |                     |                   | 0.024    |
| Early (<5 yr), n (%)             | 78 (22.5)       | 45 (20.3)             | 11 (16.4)           | 22 (38.6)         |          |
| Mid (5–19 yr), n (%)             | 150 (43.4)      | 97 (43.7)             | 34 (50.7)           | 19 (33.3)         |          |
| Late (20+ yr), n (%)             | 118 (34.1)      | 80 (36.0)             | 22 (32.8)           | 16 (28.1)         |          |
| <b>Work and health</b>           |                 |                       |                     |                   |          |
| Job satisfaction, mean (SD)      | 8.42 (1.75)     | 9.09 (1.43)           | 7.55 (1.44)         | 6.88 (1.80)       | <0.001   |
| Intent to leave, mean (SD)       | 3.82 (3.60)     | 3.31 (3.45)           | 4.67 (3.52)         | 4.79 (3.92)       | 0.002    |
| Fair/poor physical health, n (%) | 66 (19.1)       | 34 (15.3)             | 20 (29.9)           | 12 (21.1)         | 0.027    |
| Sleep (hrs/day), mean (SD)       | 6.64 (1.13)     | 6.90 (1.01)           | 6.24 (1.19)         | 6.09 (1.17)       | <0.001   |
| Exercise (0–3), mean (SD)        | 1.52 (0.99)     | 1.56 (0.97)           | 1.39 (1.07)         | 1.53 (1.00)       | 0.469    |
| GBVH exposure, n (%)             | 53 (15.3)       | 25 (11.3)             | 7 (10.4)            | 21 (36.8)         | <0.001   |
| <b>Mental health outcomes</b>    |                 |                       |                     |                   |          |
| PHQ-2 positive, n (%)            | 105 (30.3)      | 41 (18.5)             | 28 (41.8)           | 36 (63.2)         | <0.001   |
| GAD-2 positive, n (%)            | 109 (31.5)      | 45 (20.3)             | 30 (44.8)           | 34 (59.6)         | <0.001   |
| PSS-4, mean (SD)                 | 5.52 (3.19)     | 4.49 (2.80)           | 6.91 (3.11)         | 7.89 (2.87)       | <0.001   |

Table 1: p-values are from one-way ANOVA (continuous); chi-square or Fisher's exact (categorical).

**Table 2.** Interpersonal Work Environment Profile and Mental Health Models (N = 346)

|                                            | Depression<br>OR (95% CI) | Anxiety<br>OR (95% CI) | Perceived Stress<br>$\beta$ (95% CI) |
|--------------------------------------------|---------------------------|------------------------|--------------------------------------|
| <b>Model 1 (LPA profile + confounders)</b> |                           |                        |                                      |
| Isolating                                  | 2.77** (1.45, 5.28)       | 3.36*** (1.79, 6.32)   | 1.94*** (1.20, 2.68)                 |
| Hostile                                    | 5.62*** (2.76, 11.43)     | 4.81*** (2.38, 9.72)   | 2.57*** (1.75, 3.40)                 |
| R <sup>2</sup>                             | 0.278                     | 0.244                  | 0.326                                |
| <b>Model 2 (+ job satisfaction)</b>        |                           |                        |                                      |
| Isolating                                  | 1.67 (0.83, 3.34)         | 2.34* (1.20, 4.57)     | 1.27** (0.52, 2.03)                  |
| Hostile                                    | 2.61* (1.17, 5.80)        | 2.70* (1.23, 5.93)     | 1.54*** (0.67, 2.42)                 |
| Job satisfaction                           | 0.64*** (0.52, 0.78)      | 0.74** (0.62, 0.89)    | −0.51*** (−0.69, −0.32)              |
| R <sup>2</sup>                             | 0.345                     | 0.280                  | 0.379                                |

Table 2. Reference: Supportive profile. Covariates: gender, age group, career stage, self-rated physical health, sleep, exercise. Attenuation M1→M2 (Isolating): PHQ-2 49.8%, GAD-2 29.8%, PSS-4 34.4%. Attenuation M1→M2 (Hostile): PHQ-2 44.4%, GAD-2 36.7%, PSS-4 40.1%. Logistic: OR (95% CI), Nagelkerke R<sup>2</sup>; linear regression:  $\beta$  (95% CI), Adjusted R<sup>2</sup>; \*p<0.05; \*\*p<0.01; \*\*\*p<0.001.

**Table 3.** Interpersonal Work Environment and Intent to Leave Models (N=346)

| Variable       | Model A<br>(Total) | Model B<br>(+JSS)       | Model C<br>(+MH)    | Model D<br>(+both)     |
|----------------|--------------------|-------------------------|---------------------|------------------------|
| Isolating      | 1.16* (0.16, 2.16) | 0.42 (−0.60, 1.45)      | 0.47 (−0.53, 1.48)  | 0.10 (−0.93, 1.13)     |
| Hostile        | 1.10 (−0.01, 2.20) | −0.04 (−1.23, 1.16)     | 0.02 (−1.12, 1.17)  | −0.56 (−1.76, 0.64)    |
| JSS            | —                  | −0.56*** (−0.81, −0.31) | —                   | −0.39** (−0.65, −0.13) |
| PHQ-2+         | —                  | —                       | 1.59** (0.59, 2.59) | 1.39** (0.40, 2.39)    |
| GAD-2+         | —                  | —                       | 0.28 (−0.68, 1.24)  | 0.22 (−0.73, 1.17)     |
| PSS-4          | —                  | —                       | 0.16* (0.01, 0.32)  | 0.12 (−0.04, 0.27)     |
| R <sup>2</sup> | 0.040              | 0.088                   | 0.105               | 0.126                  |

Table 3. Reference: Supportive profile. All models:  $\beta$  (95% CI). Model A: profile + confounders (total association). Model B: adds job satisfaction. Model C: adds PHQ-2, GAD-2, PSS-4. Model D: adds all mediators. Attenuation A→B: Isolating 63.4%, Hostile 103.6%. Attenuation A→C: Isolating 59.2%, Hostile 97.9%. Attenuation A→D: Isolating 91.3%, Hostile 151.3%. \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .

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## **Chapter 4. Occupational Conflictual Contact, Discrimination, and Vigilance among U.S. Workers**

### **4.1 Introduction**

Discrimination is the differential treatment of individuals based on personal characteristics such as race, gender, or sexual orientation, and has been associated with adverse mental and physical health outcomes, including depression, anxiety, and cardiovascular disease in general population studies.<sup>1,2</sup> Heightened vigilance, which can be defined as anticipatory preparation for potential discrimination through environmental monitoring and behavioral modification, represents a related but distinct psychosocial burden that has been associated with adverse health outcomes such as chronic stress, anxiety, poor sleep quality, and suicidal ideation.<sup>3–6</sup> Recent research using data from the National Health Interview Survey (NHIS) reported that 14.7% of adults in the United States experience high levels of both discrimination and vigilance, with disproportionate burdens among Black, Hispanic, Asian, sexual minority, and disabled individuals.<sup>7</sup> Both discrimination and vigilance operate through chronic stress pathways that contribute to adverse health effects<sup>2,8</sup> but less is known about the occupational exposures that shape these experiences.

Working adults spend more than one-third of their adult lives in the workplace,<sup>9</sup> making it a primary environment in which exposure to discrimination may occur.<sup>10</sup> Occupational discrimination can manifest as disadvantages in hiring, promotion, and pay, but it may also apply to interpersonal experiences, such as harassment and microaggressions.<sup>11,12</sup> Experiences of occupational discrimination have been associated with depressive symptoms, psychological distress, hypertension, and alcohol abuse among workers.<sup>10,12–14</sup> Heightened vigilance in the workplace is characterized by hyperawareness of interpersonal dynamics, such as carefully

monitoring one's own behavior, appearance, or speech, to navigate potentially threatening environments and has been associated with decreased job satisfaction and increased stress.<sup>15,16</sup> Occupational stressors are not equally distributed across the workforce: a cohort study of U.S. working adults found that the prevalence of reported discrimination was 60% higher among Black workers compared to White workers, and 53% higher among women than men.<sup>17</sup> Women are also concentrated in occupations involving frequent direct contact with the public,<sup>18</sup> such as customer-facing retail and health and social services.

Many public-facing occupations involve frequent direct contact with customers, clients, or patients who may be unpleasant, angry, or physically aggressive.<sup>19</sup> These interactions are recognized occupational stressors that require substantial emotional labor from the worker<sup>20–22</sup> and have been linked to psychological distress, anxiety, and emotional exhaustion among service-sector workers.<sup>23</sup> A study of U.S. and Canadian flight attendants reported that exposure to workplace abuse, most often perpetrated by passengers, was associated with depression and sleep disturbance.<sup>24</sup> Workplace violence in healthcare settings has also been associated with hypervigilance, post-traumatic stress, and depression among those exposed.<sup>25–27</sup> Healthcare workers face particularly high interpersonal risks: while accounting for approximately 10% of the U.S. workforce, healthcare workers account for 48% of nonfatal workplace violence injuries.<sup>28</sup> While workplace violence and aggression has documented health effects, whether occupation-level interpersonal exposure relates to worker experiences of discrimination and vigilance has not been examined.

The U.S. Department of Labor's Occupational Information Network (O\*NET) provides ratings of work context characteristics for over 900 detailed occupation titles, including frequency with which workers in each occupation report dealing with unpleasant, angry, discourteous, or violent

people.<sup>29,30</sup> These measures offer a systematic occupation-level measure of interpersonal exposure across the U.S. labor market, which complement existing industry-specific studies of workplace violence and aggression. The objective of this study is to assess whether occupations characterized by exposure to unpleasant or violent people are associated with workers' self-reported experiences of discrimination and vigilance. We hypothesize that workers in occupations characterized by unpleasant and violent contact will report higher levels of discrimination and vigilance than workers in occupations without those characteristics.

## **4.2 Methods**

This study utilized data from the 2023 National Health Interview Survey (NHIS)<sup>31</sup> administered by the National Center for Health Statistics (NCHS), accessed from the Integrated Public Use Microdata Series (IPUMS).<sup>32</sup> The NHIS data provided individual-level sociodemographic, employment, and heightened vigilance and discrimination data. Occupational work context data were derived from the Occupational Information Network (O\*NET) OnLine database for each occupation, which is maintained by the U.S. Department of Labor.<sup>33</sup> Specifically, we examined two O\*NET work context measures: frequency of dealing with unpleasant or angry people, and frequency of dealing with physically aggressive or violent people. Data preparation and analysis consisted of four main phases: (1) extraction and processing of O\*NET work context measures, (2) development and application of a standardized crosswalk to link O\*NET and NHIS occupational classification systems, (3) creation of an analytic dataset by merging O\*NET measures with NHIS individual-level data and constructing analysis variables, and (4) implementation of survey-weighted linear regression models to examine associations between occupational work context measures and self-reported discrimination and vigilance experiences.

In 2023, the Everyday Discrimination Scale (EDS)<sup>34</sup> Short Version and the abbreviated Heightened Vigilance Scale (HVS)<sup>35,5</sup> were included in the NHIS Sample Adult interview. The EDS Short Version is a 5-item questionnaire assessing the frequency of unfair treatment,<sup>34</sup> including being treated with less courtesy or respect than others, being perceived as unintelligent, others acting as if they are afraid of you, being threatened or harassed, and receiving poor service at restaurants or stores. The abbreviated HVS is a 4-item questionnaire assessing how frequently respondents anticipate and prepare for discrimination,<sup>5,35</sup> including preparing for possible insults before leaving home, monitoring one's appearance to avoid harassment, carefully choosing words and manner of speech, and avoiding certain social situations or places. Both scales use a 5-point Likert scale ranging from 1 (very often) to 5 (never).

#### Work Context Measures

O\*NET provides detailed occupational information, including work context, at the eight-digit O\*NET-SOC code level, an extension of the 6-digit federal Standard Occupational Classification (SOC) system.<sup>36</sup> O\*NET Work Context measures are derived from standardized surveys administered to representative samples of individuals currently employed within each occupation, with scores reflecting the mean response across surveyed workers scaled to a 0-100 range, with higher scores indicating greater frequency or extent of the characteristic. We extracted two work context measures that capture specific interpersonal workplace demands. The first measure is Dealing with Unpleasant or Angry People,<sup>29</sup> asks “How frequently does the worker have to deal with unpleasant, angry, or discourteous individuals as part of the job requirements?” The second measure, Dealing with Physically Aggressive or Violent People,<sup>30</sup> asks “How frequently does this job require the worker to deal with physical aggression or violent individuals?” Both items use a frequency scale with five labeled anchors: 0 (Never), 25 (Once a

year or more, but not every month), 50 (Once a month or more, but not every week), 75 (Once a week or more, but not every day), and 100 (Every day).

### Crosswalk Development and Application

The crosswalk mapping process consisted of matching six-digit SOC codes from O\*NET data to corresponding NHIS 2-digit occupation codes. The NHIS groups SOC codes into 94 detailed occupational groups, with each NHIS occupation code corresponding to a grouping of one or more SOC codes. We followed guidance from the National Institute for Occupational Safety and Health for performing a crosswalk between NHIS and SOC codes,<sup>37</sup> checking to ensure agreement. In instances where a single SOC code corresponded to multiple NHIS occupation categories (0.6% of total SOC codes), the most frequently mapped NHIS code was selected.

To calculate work context scores for the broader NHIS occupational classification system, weighted averages of the O\*NET work context scores were calculated using the employment counts for the SOC codes comprising each NHIS occupation group. O\*NET-SOC scores were first aggregated to 6-digit SOC codes, and weights were derived from national employment counts by 6-digit SOC code published by the Bureau of Labor Statistics (BLS) 2023 Occupational Employment and Wage Statistics (OEWS).<sup>38</sup> Specifically, the weighted mean O\*NET score for each NHIS occupation code was calculated as the sum of each constituent SOC code's O\*NET score multiplied by its national employment count, divided by the total employment across all SOC codes in that NHIS group.

### Analytic Dataset and Variable Construction

O\*NET work context scores were merged with NHIS individual-level data by matching each respondent's two-digit NHIS occupation code to the corresponding weighted O\*NET scores. The

analytic sample was restricted to adults aged 18 years and older, who reported working at least 35 hours per week. Respondents indicating unemployment, non-civilian status, or missing data in any variable to be included in the model were excluded from analysis.

Occupations were classified using the O\*NET work context scales' anchors detailed above.

Occupations with an unpleasant contact score of  $\geq 50$ , corresponding to at least monthly unpleasant contact among the typical worker in a given occupation, were classified as exposed to unpleasant contact. Occupations with a violent contact score of  $\geq 25$ , corresponding to at least annual violent contact among the typical worker in a given occupation, were classified as exposed to violent contact. The lower threshold for violent contact reflects the greater severity of the underlying exposure and right-skewed distribution of violent contact scores across occupations. Each worker in the analytic sample was assigned to one of three exposure categories based on the O\*NET classification of their occupation: unexposed, unpleasant contact, or violent + unpleasant contact (referred to as 'violent contact' throughout). All workers in occupations classified as exposed to violent contact were also classified as exposed to unpleasant contact; no workers were classified as exposed to violent contact only. The exposure classifications throughout this paper reflect the typical interpersonal demands of each occupation rather than the personal exposure to unpleasant or violent contact of any individual respondent.

The discrimination and vigilance measures were constructed from Likert-scale survey items comprising two separate validated scales described above. One discrimination item, pertaining to receiving poor service at restaurants or stores, was excluded from this analysis as it does not pertain to occupational experiences of discrimination. All items used a five-point Likert scale originally coded from 1 (very often) to 5 (never), but scores were reverse-coded such that higher scores indicated more frequent experiences of discrimination or vigilance, consistent with prior

research utilizing these scales.<sup>5,39</sup> Reverse-coded items were summed to produce separate composite measures for discrimination and vigilance, each ranging from 4-20. Internal consistency was acceptable for both the EDS ( $\alpha = 0.66$ ) and the HVS ( $\alpha = 0.71$ ) composites; EDS and HVS items and reliability statistics are reported in Table S9. For regression analyses, we standardized both composite scores (mean = 0, standard deviation = 1) to facilitate interpretation.

Individual-level covariates were constructed as follows. Sex was coded as a binary variable (male, female). Race and ethnicity followed a mutually exclusive categorization with Hispanic identity taking precedence, resulting in categories for White, Black, Hispanic, Asian, and Other (including Native American, mixed race, and other categories). Educational attainment was collapsed into three categories: high school or less, some college (including associate's degrees and trade or technical certifications), and bachelor's degree or higher. Sexual orientation was coded into two categories: straight and sexual minority (combining lesbian/gay, bisexual, and something else responses). Additional covariates included age (continuous, standardized as mean = 0, standard deviation = 1), family income-to-poverty ratio, reported in tables as “poverty ratio” (continuous, standardized as mean = 0, standard deviation = 1), nativity status (U.S.-born, foreign-born), marital status (married/cohabiting, never married, previously married), and disability status (any disability, no disability).

### Model Development and Implementation

Survey-weighted linear regression models were used to examine associations between occupational exposure group and standardized discrimination and vigilance scores. NHIS survey sampling weights were applied to all analyses. Two models were fit, one for each outcome, with

occupational exposure group as the focal predictor and adjusted for sociodemographic covariates. All analyses were conducted in R version 4.5.2.<sup>40</sup>

### **4.3 Results**

#### Sample Characteristics

The analytic sample consisted of 12,462 full-time workers with complete data for all study variables (Table 1); characteristics reported here are survey-weighted. The mean age was 42.3 years (SD = 13.4). More than half (57%) of the sample was male and the majority (61%) self-identified as White. Nearly half (42%) had completed a bachelor's or higher, and the mean family income-to-poverty ratio was 4.91 (SD = 2.97), indicating the average family income was approximately five times the federal poverty threshold. The vast majority (94%) identified as straight and were born in the U.S. (80%). More than half (64%) were married or cohabiting. Disability prevalence was low at 3.3%, which may reflect the full-time employment inclusion criterion. Mean discrimination and vigilance scores among workers in the sample were 6.27 (SD = 2.86) and 7.74 (SD = 4.04) respectively, with scores ranging from 4 to 20.

Approximately 49% of workers were in unexposed occupations, 35% in unpleasant contact occupations, and 16% in violent contact occupations. Demographic composition varied across these groups. Workers in violent contact occupations were more likely to be female (65%), compared to 48% of workers in unpleasant contact occupations and 32% of workers in unexposed occupations. Workers in violent contact occupations were also more likely to hold a bachelor's degree or higher (61%), versus 39% in unexposed occupations. Black workers and sexual minority workers were also more represented in violent contact occupations relative to unexposed occupations.

## Model Results

In adjusted models, exposure to unpleasant contact was not associated with discrimination ( $\beta = -0.006$ , 95% CI:  $-0.051, 0.039$ ) or vigilance ( $\beta = -0.001$ , 95% CI:  $-0.045, 0.044$ ) compared to unexposed (Table 2). Exposure to violent contact was associated with higher vigilance ( $\beta = 0.076$ , 95% CI:  $0.013, 0.140$ ) but not discrimination ( $\beta = 0.038$ , 95% CI:  $-0.022, 0.099$ ). Models explained 7.1% of variance in discrimination scores and 7.2% of variance in vigilance scores. Full coefficients for all covariates in the models are reported in Table S10.

## **4.4 Discussion**

This study found that workers in occupations classified as exposed to violent or physically aggressive individuals reported higher vigilance than workers in unexposed occupations, while workers in occupations classified as exposed to unpleasant or angry people did not differ from unexposed occupations on either discrimination or heightened vigilance.

To our knowledge, no prior study has explored whether occupations characterized by frequent unpleasant or violent contact, as captured by occupation-level work context measures, are associated with workers' self-reported experiences of discrimination and heightened vigilance, which precludes direct comparison to previous evidence. However, research on workplace incivility indicates that rude or discourteous interactions are typically appraised as ambiguous in meaning,<sup>20,41</sup> whereas physical aggression and other forms of workplace violence are more reliably appraised as threatening and have been associated with fear, anxiety, and post-traumatic stress among exposed workers.<sup>20,26</sup> Occupations with more frequent experiences of violence, such as nursing, represent work contexts wherein exposure to, or fear of, violence produces environments in which workers generally feel less safe.<sup>42</sup> Routine contact with unpleasant

individuals, in the absence of clear threat or risk of harm, may instead elicit more mild or mixed appraisals of incivility rather than sustained vigilance.<sup>41</sup>

The composition of the analytic sample also reflects the unequal distribution of unpleasant and violent occupational exposures across demographic groups. Women, Black, and sexual minority workers were each overrepresented in occupations classified as exposed to violent contact compared to unexposed occupations. This pattern is consistent with broader evidence of occupational segregation in the U.S. workforce, where workers are distributed across and within occupations based on demographic characteristics, concentrating certain groups into occupations where there are increased psychosocial exposures.<sup>43</sup> Women in particular were overrepresented in occupations exposed to violent contact, consistent with national statistics that 73% of workers who experience trauma from nonfatal workplace violence requiring time off work are women.<sup>44</sup> These patterns of occupational segregation may contribute to the elevated experiences of discrimination and vigilance reported by women, Black, and sexual minority workers nationally.<sup>7</sup>

These findings carry implications for practice and policy, particularly for how organizations address psychosocial hazards in the workplace. The Occupational Safety and Health Administration (OSHA) currently has no specific standard regarding exposure to workplace violence; in the absence of a federal standard, twenty-seven states have enacted workplace violence prevention laws for healthcare specifically,<sup>45</sup> and California recently expanded workplace violence prevention requirements to general industry, requiring employers to establish, implement, and maintain a Workplace Violence Prevention Plan that includes hazard identification and assessment, employee training, incident reporting and investigation, and post-incident response procedures.<sup>46</sup> Recent commentary on work-related psychosocial hazards recommends applying the hierarchy of controls, with organizational interventions prioritized

over individual interventions because they are more efficient, have broader impact, and benefit all workers including those who cannot access individual services.<sup>47</sup> A qualitative study of Danish companies with initiatives to address occupational psychosocial hazards found that multifaceted measures combining both organizational and individual approaches were viewed as effective by employees and management.<sup>48</sup> Higher-level interventions identified in the Danish companies included increasing staffing levels, restructuring work processes, and modifying physical premises to enhance worker safety, while lower-level interventions included violence policies, de-escalation training, and post-incident debriefing or crisis counseling. The association between violent occupational exposure and vigilance in this study suggests that workplace violence prevention programs in high-exposure sectors may carry psychosocial benefits in addition to injury prevention.

This study has several limitations to consider. First, the discrimination and vigilance scores are not particular to the workplace; though the inclusion criteria and exclusion of items irrelevant to the workplace were intended to capture more of these experiences in occupational contexts, residual measurement of non-workplace discrimination and vigilance cannot be ruled out. Similarly, exposure was assigned at the level of the occupation rather than reflecting a measure of exposure for an individual; as such, we cannot confirm whether any given respondent personally experiences the exposures characteristic of their occupation. Second, the broad NHIS 2-digit occupational classification and weighted averaging of O\*NET work context scores across multiple SOC codes introduce measurement imprecision at the occupation level and do not capture intra-occupation variability in exposure that likely vary between individuals based on their race, gender, or other characteristics leading to differing experiences. Third, the magnitude of the associations between occupational exposures to unpleasant and violent contact was small

in absolute terms; the substantially larger associations observed for sociodemographic variables indicate that individual-level characteristics are the dominant correlates of discrimination and vigilance among workers. Finally, the models accounted for less than 10% of the observed variance in discrimination and vigilance scores, which reflects unmeasured factors not available for this analysis.

#### **4.5 Conclusion**

This study found that occupation-level exposure to violent or physically aggressive people was associated with heightened vigilance among this sample of full-time U.S. workers who participated in the 2023 NHIS, while exposure to unpleasant or angry people alone was not associated with either discrimination or vigilance. Women, Black, and sexual minority workers were each overrepresented in occupations classified as exposed to violent contact, which reflects the unequal distribution of workers by demographic groups into occupations with high prevalence of violence. Reducing the burden of exposure to workplace violence will require comprehensive workplace violence prevention strategies that incorporate both organizational and individual interventions. Future research should seek to assess how exposure to violence at the level of the individual worker relates to occupational discrimination and vigilance, developing and using workplace-specific discrimination and vigilance scales that isolate occupational from non-occupational sources.

## Chapter 4 Tables

**Table 1.** Sample Characteristics Stratified by Occupational Exposure Group (N = 12,462)

| Variable                                | Full Sample<br>(N = 12,462) | Unexposed<br>(n = 6,010) | Unpleasant<br>(n = 4,328) | Violent<br>(n = 2,124) | <i>p</i> |
|-----------------------------------------|-----------------------------|--------------------------|---------------------------|------------------------|----------|
| <b>Work Context Scores</b>              |                             |                          |                           |                        |          |
| Unpleasant Contact, mean (SD)           | 50.60 (10.78)               | —                        | —                         | —                      | —        |
| Violent + Unpleasant Contact, mean (SD) | 15.13 (9.71)                | —                        | —                         | —                      | —        |
| <b>Outcome Measures</b>                 |                             |                          |                           |                        |          |
| Discrimination, mean (SD)               | 6.27 (2.86)                 | 6.17 (2.78)              | 6.27 (2.88)               | 6.56 (3.04)            | <0.001   |
| Vigilance, mean (SD)                    | 7.74 (4.04)                 | 7.59 (3.94)              | 7.70 (4.05)               | 8.27 (4.26)            | <0.001   |
| <b>Sociodemographic Characteristics</b> |                             |                          |                           |                        |          |
| Age (years), mean (SD)                  | 42.33 (13.37)               | 42.21 (13.35)            | 42.89 (13.54)             | 41.52 (13.02)          | 0.006    |
| Sex, n (%)                              |                             |                          |                           |                        | <0.001   |
| Male                                    | 6,644 (57.0%)               | 3,877 (67.8%)            | 2,103 (52.2%)             | 664 (34.9%)            |          |
| Female                                  | 5,818 (43.0%)               | 2,133 (32.2%)            | 2,225 (47.8%)             | 1,460 (65.1%)          |          |
| Race/Ethnicity, n (%)                   |                             |                          |                           |                        | <0.001   |
| White                                   | 7,862 (60.8%)               | 3,709 (59.3%)            | 2,809 (62.3%)             | 1,344 (62.0%)          |          |
| Black                                   | 1,328 (11.6%)               | 558 (9.9%)               | 490 (12.5%)               | 280 (14.9%)            |          |
| Hispanic                                | 2,075 (18.0%)               | 1,116 (20.7%)            | 673 (16.6%)               | 286 (12.9%)            |          |
| Asian                                   | 862 (6.9%)                  | 488 (7.9%)               | 225 (5.5%)                | 149 (7.1%)             |          |
| Other                                   | 335 (2.7%)                  | 139 (2.2%)               | 131 (3.1%)                | 65 (3.1%)              |          |
| Educational Attainment, n (%)           |                             |                          |                           |                        | <0.001   |
| High school or less                     | 3,300 (30.4%)               | 1,847 (34.9%)            | 1,173 (30.7%)             | 280 (16.3%)            |          |
| Some college                            | 3,242 (28.0%)               | 1,464 (26.4%)            | 1,344 (32.5%)             | 434 (23.1%)            |          |
| Bachelor's or higher                    | 5,920 (41.6%)               | 2,699 (38.7%)            | 1,811 (36.8%)             | 1,410 (60.6%)          |          |
| Poverty Ratio, mean (SD)                | 4.91 (2.97)                 | 4.88 (3.03)              | 4.85 (2.89)               | 5.12 (2.95)            | 0.011    |
| Sexual Orientation, n (%)               |                             |                          |                           |                        | 0.013    |
| Straight                                | 11,695 (94.1%)              | 5,682 (94.6%)            | 4,060 (94.0%)             | 1,953 (92.6%)          |          |
| Sexual minority                         | 767 (5.9%)                  | 328 (5.4%)               | 268 (6.0%)                | 171 (7.4%)             |          |
| Nativity Status, n (%)                  |                             |                          |                           |                        | <0.001   |
| U.S.-born                               | 10,149 (80.2%)              | 4,662 (76.2%)            | 3,678 (83.5%)             | 1,809 (85.2%)          |          |
| Foreign-born                            | 2,313 (19.8%)               | 1,348 (23.8%)            | 650 (16.5%)               | 315 (14.8%)            |          |
| Marital Status, n (%)                   |                             |                          |                           |                        | 0.102    |

|                          |                |               |               |               |       |
|--------------------------|----------------|---------------|---------------|---------------|-------|
| Married/Cohabiting       | 6,937 (64.4%)  | 3,312 (64.5%) | 2,420 (64.6%) | 1,205 (63.9%) |       |
| Never married            | 3,084 (23.1%)  | 1,571 (23.7%) | 990 (22.0%)   | 523 (24.0%)   |       |
| Previously married       | 2,441 (12.4%)  | 1,127 (11.8%) | 918 (13.4%)   | 396 (12.1%)   |       |
| Disability Status, n (%) |                |               |               |               | 0.061 |
| No disability            | 12,038 (96.7%) | 5,819 (96.8%) | 4,182 (97.0%) | 2,037 (95.7%) |       |
| Any disability           | 424 (3.3%)     | 191 (3.2%)    | 146 (3.0%)    | 87 (4.3%)     |       |

Table 1. Estimates are survey-weighted; counts are unweighted. p-values are from design-adjusted Wald tests for continuous variables and Rao-Scott chi-square tests for categorical variables

**Table 2.** Occupational Interpersonal Exposures and Discrimination and Vigilance Models (N = 12,462)

| Occupational Exposure        | Discrimination |               | Vigilance |               |
|------------------------------|----------------|---------------|-----------|---------------|
|                              | $\beta$        | 95% CI        | $\beta$   | 95% CI        |
| Unexposed                    | —              | —             | —         | —             |
| Unpleasant Contact           | -0.006         | -0.051, 0.039 | -0.001    | -0.045, 0.044 |
| Violent + Unpleasant Contact | 0.038          | -0.022, 0.099 | 0.076*    | 0.013, 0.140  |
| R <sup>2</sup>               | 0.071          |               | 0.072     |               |

Table 2.  $\beta$  = regression coefficient for standardized outcome (SD units); CI = Confidence Interval; Reference category: Unexposed; Models adjusted for age, sex, race/ethnicity, education, family income-to-poverty ratio, sexual orientation, nativity, marital status, and disability status; \*  $p < 0.05$ .

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## Chapter 5: Conclusion

The work presented here is the first to characterize organizational and interpersonal psychosocial hazards among U.S. mariners using both qualitative and quantitative methods, and among the first to examine occupation-level interpersonal exposure in relation to worker-reported discrimination and vigilance across the U.S. workforce. Mariners surveyed during COVID-19 identified inadequate shoreside support, restricted shore leave, and inconsistent application of controls as the most common stressors, and they called for organizational solutions such as consistent protocol application and communication. Among U.S. mariners surveyed in 2025, the shipboard interpersonal work environment fell into three clear configurations: Supportive, Isolating, and Hostile, with the latter two carrying substantially elevated mental health burden and intent to leave. Across the broader U.S. workforce, occupation-level exposure to violent contact tracked with heightened worker vigilance, with women, Black, and sexual minority workers disproportionately concentrated in occupations exposed to violent contact.

U.S. mariners are essential workers, and their mental health and well-being have implications for retention in a sector strained by the highest labor shortfall on record.<sup>1</sup> The findings herein point to organizational conditions as modifiable exposures most associated with mariner mental health, consistent with NIOSH and Total Worker Health guidance that weigh organizational over individual interventions as more impactful and sustainable.<sup>2,3</sup> Maritime regulation is moving in this direction. Amendments to international maritime code that entered into force in January 2026 now require mandatory training to prevent and respond to shipboard violence, harassment, bullying, sexual harassment, and sexual assault.<sup>4</sup> Future research is called for to evaluate the impact of this regulatory shift. Using available evidence to address isolating environments suggests shared workgroup activities and structured peer support as interventions with empirical

support.<sup>5</sup> Longitudinal designs with multi-level and multi-model approaches are needed to clarify how interpersonal exposures, job satisfaction, and mental health change and interact over time. Studies with larger samples to characterize differential exposure within the maritime population, especially minoritized groups, are needed.

For the broader U.S. workforce, the association between occupation-level violent contact and worker vigilance suggests that comprehensive workplace violence prevention programs in high-exposure sectors have potential to improve worker safety, physical health, and mental well-being. Policy and regulatory standards to prevent workplace violence are gaining momentum but are far from universal. The U.S. Occupational Safety and Health Administration has no federal workplace violence standard, but California has extended workplace violence prevention requirements to general industry that have been in effect since 2024.<sup>6</sup> The research herein identified a need for individual-level measures of workplace violence within the general workforce to disentangle occupational, environmental, and personal risk factors. Definitions and language for workplace violence also remain inconsistent across studies and disciplines, complicating measurement and evidence synthesis.<sup>7,8</sup> Finally, the study of interpersonal psychosocial exposures would benefit from theoretical models that capture how exposures co-occur, accumulate, and interact with worker identity and organizational context.<sup>9,10</sup>

## Chapter 5 References

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## Appendix

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Table S1. Scale Reliability for Composite Measures

| Measure                                            | k | Cronbach's $\alpha$ | 95% CI         |
|----------------------------------------------------|---|---------------------|----------------|
| SNAQ-Personal (Negative interpersonal experiences) | 6 | 0.878               | (0.859, 0.896) |
| Positive Interpersonal Experiences                 | 4 | 0.615               | (0.558, 0.672) |
| JSS-3 (Job Satisfaction Survey, 3-item)            | 3 | 0.646               | (0.582, 0.710) |
| PHQ-2 (Patient Health Questionnaire)               | 2 | 0.839               | (0.805, 0.873) |
| GAD-2 (Generalized Anxiety Disorder)               | 2 | 0.860               | (0.830, 0.889) |
| PSS-4 (Perceived Stress Scale)                     | 4 | 0.819               | (0.787, 0.851) |

Table S1. 95% CIs based on analytic standard error. k = number of items. All scales fell within the acceptable range ( $>0.60$ ).

Table S2. Profile Coefficients under Two Gender Coding Schemes

|                                               | Depression (PHQ-2)       |                          | Anxiety (GAD-2)         |                         | Perceived stress (PSS-4) |                         |
|-----------------------------------------------|--------------------------|--------------------------|-------------------------|-------------------------|--------------------------|-------------------------|
|                                               | Primary                  | Sensitivity              | Primary                 | Sensitivity             | Primary                  | Sensitivity             |
| Panel 1: Model 1 (profile + confounders)      |                          |                          |                         |                         |                          |                         |
| Isolating                                     | 2.77**<br>(1.45, 5.28)   | 2.87**<br>(1.51, 5.45)   | 3.36***<br>(1.79, 6.32) | 3.25***<br>(1.73, 6.10) | 1.94***<br>(1.20, 2.68)  | 1.92***<br>(1.19, 2.66) |
| Hostile                                       | 5.62***<br>(2.76, 11.43) | 5.70***<br>(2.80, 11.59) | 4.81***<br>(2.38, 9.72) | 4.94***<br>(2.45, 9.98) | 2.57***<br>(1.75, 3.40)  | 2.54***<br>(1.73, 3.36) |
| Panel 2: Model 2 (Model 1 + job satisfaction) |                          |                          |                         |                         |                          |                         |
| Isolating                                     | 1.67<br>(0.83, 3.34)     | 1.71<br>(0.86, 3.41)     | 2.34*<br>(1.20, 4.57)   | 2.26*<br>(1.16, 4.42)   | 1.27**<br>(0.52, 2.03)   | 1.25**<br>(0.50, 2.00)  |
| Hostile                                       | 2.61*<br>(1.17, 5.80)    | 2.63*<br>(1.18, 5.84)    | 2.70*<br>(1.23, 5.93)   | 2.80**<br>(1.28, 6.14)  | 1.54***<br>(0.67, 2.42)  | 1.52***<br>(0.65, 2.39) |

Table S2. Primary N = 346 (Male/Female only); sensitivity N = 350 (Male/Non-male, with “Other” collapsed into Non-male). Reference category: Supportive profile. Covariates: gender, age group, career stage, self-rated physical health, sleep, exercise. Coefficients change by <5% between primary and sensitivity model specifications with no change in statistical significance. Logistic regression: OR (95% CI); linear regression:  $\beta$  (95% CI); \*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$ .

Table S3. Respondents Included vs. Excluded from the Regression Analytic Sample

| Variable                   | Included<br>(n=346) | Excluded<br>(n=76) | p      |
|----------------------------|---------------------|--------------------|--------|
| Female, n (%)              | 45 (13.0%)          | 9 (11.8%)          | 0.567  |
| Non-White, n (%)           | 35 (10.1%)          | 26 (34.2%)         | <0.001 |
| Age 18–34, n (%)           | 153 (44.2%)         | 20 (26.3%)         | 0.073  |
| PHQ-2 positive, n (%)      | 105 (30.3%)         | 22 (28.9%)         | 0.972  |
| GAD-2 positive, n (%)      | 109 (31.5%)         | 25 (32.9%)         | 0.864  |
| PSS-4, mean (SD)           | 5.52 (3.19)         | 6.01 (3.38)        | 0.256  |
| JSS, mean (SD)             | 8.42 (1.75)         | 7.97 (1.50)        | 0.025  |
| Intent to leave, mean (SD) | 3.82 (3.60)         | 5.02 (3.55)        | 0.045  |

Table S3. Excluded respondents had missing data on at least one covariate or outcome required for regression analysis. p-values:  $\chi^2$  or Fisher's exact (categorical); independent-samples t-test (continuous).

Table S4. Latent Profile Analysis Fit Statistics

| Mode<br>l  | K        | Log-lik             | AIC                | BIC                 | saBIC              | Entropy      | Min<br>AveP  | %<br>>0.9<br>0 | Min<br>n  | Note            |
|------------|----------|---------------------|--------------------|---------------------|--------------------|--------------|--------------|----------------|-----------|-----------------|
| EEI        | 2        | -1707.<br>7         | 3509.<br>4         | -3475.<br>8         | 3550.<br>4         | 0.712        | 0.909        | 72.7           | 164       |                 |
| EEI        | 3        | -1660.<br>1         | 3464.<br>2         | -3404.<br>8         | 3527.<br>0         | 0.743        | 0.820        | 62.6           | 70        |                 |
| EEI        | 4        | -1555.<br>8         | 3317.<br>6         | -3220.<br>5         | 3407.<br>4         | 0.947        | 0.867        | 90.8           | 50        |                 |
| EVI        | 2        | NA                  | NA                 | NA                  | NA                 | NA           | NA           | NA             | NA        | Failed          |
| EVI        | 3        | -1659.<br>5         | 3457.<br>1         | -3427.<br>9         | 3517.<br>2         | 0.750        | 0.823        | 63.3           | 69        |                 |
| EVI        | 4        | NA                  | NA                 | NA                  | NA                 | NA           | NA           | NA             | NA        | Failed          |
| VEI        | 2        | -1705.<br>8         | 3489.<br>6         | -3478.<br>1         | 3523.<br>6         | 0.677        | 0.896        | 68.2           | 176       |                 |
| <b>VEI</b> | <b>3</b> | <b>-1655.<br/>9</b> | <b>3441.<br/>9</b> | <b>-3408.<br/>6</b> | <b>3498.<br/>5</b> | <b>0.794</b> | <b>0.826</b> | <b>71.3</b>    | <b>72</b> | <b>Selected</b> |
| VEI        | 4        | -1441.<br>8         | 3077.<br>7         | -3010.<br>6         | 3162.<br>2         | 0.982        | 0.956        | 96.7           | 51        | Sensitivity     |
| VVI        | 2        | -1675.<br>0         | 3438.<br>0         | -3428.<br>6         | 3476.<br>4         | 0.714        | 0.903        | 72.5           | 159       |                 |
| VVI        | 3        | -1654.<br>7         | 3457.<br>3         | -3430.<br>2         | 3521.<br>8         | 0.801        | 0.796        | 73.5           | 73        |                 |
| VVI        | 4        | NA                  | NA                 | NA                  | NA                 | NA           | NA           | NA             | NA        | Failed          |

Table S4. EEI/VEI/EVI/VVI = diagonal Gaussian mixture covariance structures. BIC = Bayesian Information Criterion. saBIC = sample-size-adjusted BIC. AvePP = mean posterior probability within class.

Table S5. Interpersonal Environment Profile Association with Job Satisfaction Ordinary Least Squares (OLS)

| Predictor                 | $\beta$  | 95% CI         | p      |
|---------------------------|----------|----------------|--------|
| Isolating                 | -1.31*** | (-1.73, -0.90) | <0.001 |
| Hostile                   | -2.03*** | (-2.49, -1.57) | <0.001 |
| Female (ref: Male)        | 0.32     | (-0.17, 0.80)  | 0.204  |
| Age 35–44 (ref: 18–34)    | -0.30    | (-0.76, 0.17)  | 0.209  |
| Age 45–54                 | 0.19     | (-0.45, 0.84)  | 0.557  |
| Age 55+                   | 0.26     | (-0.42, 0.95)  | 0.449  |
| Mid-career (ref: Early)   | 0.10     | (-0.36, 0.55)  | 0.676  |
| Late career               | 0.34     | (-0.35, 1.03)  | 0.336  |
| Fair/poor physical health | -0.30    | (-0.73, 0.13)  | 0.169  |
| Sleep (hours/24 h)        | 0.24**   | (0.09, 0.38)   | 0.002  |
| Exercise (0–3)            | -0.03    | (-0.20, 0.14)  | 0.744  |
| Adjusted R <sup>2</sup>   | 0.304    |                |        |

Table S5. OLS linear regression; outcome is JSS-3 job satisfaction (range 3–12; higher = more satisfied). This model estimates the total adjusted association between interpersonal work environment profile and job satisfaction. Sleep was the only covariate independently associated with job satisfaction ( $\beta = 0.24$ ,  $p = 0.002$ ). \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .

Table S6. Profile Coefficients with and without Gender-Based Violence and Harassment Exposure

| Outcome                  | Profile   | Without GBVH          | With GBVH             | GBVH coefficient   |
|--------------------------|-----------|-----------------------|-----------------------|--------------------|
| Depression (PHQ-2)       | Isolating | 2.77** (1.45, 5.28)   | 2.78** (1.46, 5.29)   | 0.86 (0.29, 2.59)  |
| Depression (PHQ-2)       | Hostile   | 5.62*** (2.76, 11.43) | 5.68*** (2.78, 11.61) |                    |
| Anxiety (GAD-2)          | Isolating | 3.36*** (1.79, 6.32)  | 3.35*** (1.78, 6.30)  | 1.54 (0.52, 4.54)  |
| Anxiety (GAD-2)          | Hostile   | 4.81*** (2.38, 9.72)  | 4.67*** (2.30, 9.49)  |                    |
| Perceived stress (PSS-4) | Isolating | 1.94*** (1.20, 2.68)  | 1.94*** (1.19, 2.68)  | 0.48 (−0.81, 1.77) |
| Perceived stress (PSS-4) | Hostile   | 2.57*** (1.75, 3.40)  | 2.54*** (1.71, 3.37)  |                    |
| Intent to leave          | Isolating | 1.16* (0.16, 2.16)    | 1.15* (0.15, 2.14)    | 1.44 (−0.29, 3.18) |
| Intent to leave          | Hostile   | 1.10 (−0.01, 2.20)    | 1.00 (−0.12, 2.11)    |                    |

Table S6. N = 346. Logistic regression for PHQ-2, GAD-2 (OR, 95% CI); OLS for PSS-4, intent to leave ( $\beta$ , 95% CI). Profile coefficients change by <5% with GBVH added, no change in significance, confirming stability. \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$

Table S7. Latent Profile Analysis (LPA) Classification Probabilities

| Assigned profile | n   | Supportive   | Isolating    | Hostile      |
|------------------|-----|--------------|--------------|--------------|
| Supportive       | 261 | <b>0.919</b> | 0.069        | 0.012        |
| Isolating        | 89  | 0.127        | <b>0.826</b> | 0.047        |
| Hostile          | 72  | 0.015        | 0.025        | <b>0.961</b> |

Table S7. N = 422. Rows denote profile of modal assignment; columns show mean posterior probability of class membership. Diagonal elements (bolded) represent within-profile classification confidence (higher = more confident assignment); off-diagonal elements indicate degree of class overlap. Values  $\geq 0.80$  indicate adequate classification reliability.

Table S8. Full Adjusted Model Coefficients

| Predictor                            | Depression<br>(OR)   | Anxiety<br>(OR)     | PSS-4 ( $\beta$ )       | Intent to Leave<br>( $\beta$ ) |
|--------------------------------------|----------------------|---------------------|-------------------------|--------------------------------|
| Isolating profile                    | 1.67 (0.83, 3.34)    | 2.34* (1.20, 4.57)  | 1.27** (0.52, 2.03)     | 0.10 (−0.93, 1.13)             |
| Hostile profile                      | 2.61* (1.17, 5.80)   | 2.70* (1.23, 5.93)  | 1.54*** (0.67, 2.42)    | −0.56 (−1.76, 0.64)            |
| Job satisfaction (per 1 unit)        | 0.64*** (0.52, 0.78) | 0.74** (0.62, 0.89) | −0.51*** (−0.69, −0.32) | −0.39** (−0.65, −0.13)         |
| Female (vs. male)                    | 2.22* (1.00, 4.91)   | 2.38* (1.12, 5.09)  | 1.12** (0.28, 1.96)     | 0.40 (−0.74, 1.54)             |
| Age 35–44                            | 0.61 (0.28, 1.36)    | 0.72 (0.34, 1.56)   | −0.45 (−1.25, 0.35)     | −0.88 (−1.96, 0.19)            |
| Age 45–54                            | 0.26* (0.07, 0.91)   | 0.44 (0.14, 1.42)   | −0.89 (−2.00, 0.22)     | −0.33 (−1.83, 1.16)            |
| Age 55+                              | 0.24* (0.07, 0.89)   | 0.30 (0.09, 1.03)   | −2.00*** (−3.18, −0.82) | −0.62 (−2.22, 0.99)            |
| Career: Mid (5–19 yr)                | 0.56 (0.27, 1.17)    | 0.43* (0.21, 0.87)  | −0.81* (−1.59, −0.03)   | 0.94 (−0.12, 2.00)             |
| Career: Late (20+ yr)                | 1.22 (0.35, 4.26)    | 0.84 (0.26, 2.71)   | −0.28 (−1.47, 0.91)     | 0.62 (−0.97, 2.21)             |
| Fair/poor physical health            | 1.37 (0.67, 2.81)    | 1.55 (0.78, 3.08)   | 1.17** (0.44, 1.91)     | −0.69 (−1.69, 0.32)            |
| Sleep (hours/24 h)                   | 0.83 (0.64, 1.08)    | 1.07 (0.83, 1.36)   | −0.23 (−0.49, 0.03)     | −0.11 (−0.46, 0.24)            |
| Exercise (0–3)                       | 0.77 (0.57, 1.04)    | 0.82 (0.62, 1.09)   | −0.48** (−0.77, −0.19)  | 0.14 (−0.25, 0.54)             |
| Depression screen (PHQ-2 $\geq$ 3)   | —                    | —                   | —                       | 1.39** (0.40, 2.39)            |
| Anxiety screen (GAD-2 $\geq$ 3)      | —                    | —                   | —                       | 0.22 (−0.73, 1.17)             |
| Perceived stress (PSS-4, per 1 unit) | —                    | —                   | —                       | 0.12 (−0.04, 0.27)             |

Table S8. N = 346. Full adjusted model coefficients for regression models (Table 2 and 3). PHQ-2 and GAD-2: logistic regression (odds ratios reported). PSS-4 and intent to leave: linear regression (unstandardized  $\beta$  reported). Reference categories: Supportive profile; Male; Age 18–34; Career early (<5 yr); Good or better physical health. \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .

Table S9. Internal Consistency Reliability of Discrimination and Vigilance Scales

| Item                                                       | Mean | SD   | Item-Rest<br>Correlation | $\alpha$ if Deleted |
|------------------------------------------------------------|------|------|--------------------------|---------------------|
| Everyday Discrimination Scale (4 items; $\alpha = 0.663$ ) |      |      |                          |                     |
| Treated with less courtesy or respect                      | 2.09 | 1.29 | 0.510                    | 0.561               |
| People act as if you are not smart                         | 1.59 | 1.08 | 0.522                    | 0.539               |
| People act as if afraid of you                             | 1.33 | 0.84 | 0.354                    | 0.651               |
| You are threatened or harassed                             | 1.30 | 0.76 | 0.447                    | 0.608               |
| Heightened Vigilance Scale (4 items; $\alpha = 0.709$ )    |      |      |                          |                     |
| Prepare for possible insults before leaving home           | 1.51 | 1.16 | 0.469                    | 0.665               |
| Carefully watch your appearance                            | 1.47 | 1.09 | 0.512                    | 0.648               |
| Carefully watch what you say and how you say it            | 2.79 | 1.75 | 0.512                    | 0.659               |
| Try to avoid certain places or social situations           | 1.98 | 1.38 | 0.550                    | 0.612               |

Table S9. N = 12,462. ' $\alpha$  if Deleted' is the scale alpha computed when that item is removed; One item regarding receiving poor service at restaurants was removed from EDS for this analysis

Table S10. Full Covariate-Adjusted Regression Results for Discrimination and Vigilance

| Variable               |                      | Discrimination |                | Vigilance     |                |
|------------------------|----------------------|----------------|----------------|---------------|----------------|
|                        |                      | $\beta$        | 95% CI         | $\beta$       | 95% CI         |
| Occupational Exposure  | Unexposed            | —              | —              | —             | —              |
|                        | Unpleasant           | -0.006         | -0.051, 0.039  | -0.001        | -0.045, 0.044  |
|                        | Violent + Unpleasant | 0.038          | -0.022, 0.099  | 0.076*        | 0.013, 0.140   |
| Age (scaled)           |                      | -0.080***      | -0.102, -0.058 | -0.080***     | -0.103, -0.057 |
| Sex                    | Male                 | —              | —              | —             | —              |
|                        | Female               | 0.068**        | 0.025, 0.111   | 0.034         | -0.010, 0.078  |
| Race/Ethnicity         | White                | —              | —              | —             | —              |
|                        | Black                | 0.368***       | 0.283, 0.453   | 0.489***      | 0.405, 0.572   |
|                        | Hispanic             | -0.068*        | -0.130, -0.006 | 0.040         | -0.025, 0.104  |
|                        | Asian                | 0.040          | -0.047, 0.126  | 0.134**       | 0.043, 0.225   |
|                        | Other                | 0.190*         | 0.029, 0.351   | 0.228**       | 0.061, 0.395   |
| Educational Attainment | High School or less  | —              | —              | —             | —              |
|                        | Some College         | 0.062*         | 0.007, 0.117   | 0.069*        | 0.014, 0.124   |
|                        | Bachelor's or higher | 0.065*         | 0.013, 0.117   | 0.126***      | 0.071, 0.182   |
| Poverty Ratio (scaled) |                      | -0.022*        | -0.019         | -0.042, 0.003 | -0.017         |
| Sexual Orientation     | Straight             | —              | —              | —             | —              |
|                        | Sexual minority      | 0.437***       | 0.341, 0.533   | 0.498***      | 0.401, 0.594   |
| Nativity Status        | U.S.-born            | —              | —              | —             | —              |
|                        | Foreign-born         | -0.212***      | -0.276, -0.148 | -0.171***     | -0.240, -0.102 |
| Marital Status         | Married/Cohabiting   | —              | —              | —             | —              |
|                        | Never married        | 0.079**        | 0.021, 0.136   | 0.071*        | 0.013, 0.129   |
|                        | Previously married   | 0.138***       | 0.081, 0.195   | 0.097**       | 0.038, 0.157   |
| Disability Status      | No disability        | —              | —              | —             | —              |
|                        | Any disability       | 0.570***       | 0.424, 0.717   | 0.474***      | 0.351, 0.598   |
| R <sup>2</sup>         |                      | 0.071          |                | 0.072         |                |

Table S10. N = 12,462. Estimates are survey-weighted. CI = Confidence Interval.  $\beta$  = standardized regression coefficient. Reference categories: Unexposed, Male, White, Straight, U.S.-born, Married/Cohabiting, High school or less, No disability. \*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$ .