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**The Chair deems the written Dissertation as satisfactory to proceed to the Oral Defense*

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Abstract

The overall prevalence of mental health continues to increase throughout the United States. Many patients who seek mental health services present with somatic symptoms. There is growing evidence suggesting that somatic symptoms are directly associated with anxiety and depression in adult patients, leading to increased health care utilization. A somatic symptom may be the first presentation of a mental health issue within the active-duty service member population. There are limited studies on the relationship between somatic symptoms and mental health within the military population. The purpose of this study is to examine the relationship between somatic symptoms, anxiety, and depression in the Department of Defense (DoD) active-duty military population. The central hypothesis for this study is that increases in somatic symptoms are directly associated with an increase in anxiety and depression symptoms in active-duty service members. This study is an original secondary data analysis on cross-sectional data collected from 16,699 participants from the DoD funded 2015 Health Related Behaviors Survey. The results of the unadjusted and adjusted multinomial logistic regression models supported the central hypothesis for this study, revealing that increases in somatic symptom burden increases the odds of higher anxiety and depression symptom severity. The results of this study provide unique military analysis supporting to the body of literature examining the relationship between somatic symptoms, anxiety, and depression. These results suggest that somatic symptoms can be a risk factor to aid in the diagnosis and treatment of active-duty service members suffering from mental health distress.

Keyworks:

Somatic Symptoms, Anxiety, Depression, Active-Duty Military

The Relationship Between Somatic Symptoms, Anxiety, and Depression in Active-Duty Service Members: 2015 Health Related Behaviors Survey

by

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Dissertation Proposal submitted to the faculty of the
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[August 2023]

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Dedication

To my amazing daughters, who served as my cheering squad, test audience, and first readers. To my parents, siblings, friends, and professional mentors, who regularly encouraged me throughout the journey. To all members of the military community who struggle with mental health, we will continue to fight for you.

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List of Abbreviations

ANCOVA	Analysis of Covariance
CFR	Code of Federal Regulations
DoD	Department of Defense
GAD - 7	Generalized Anxiety Disorder 7
HRBS	Health Related Behaviors Survey
IRB	Institutional Review Board
MLR	Multinomial Logistic Regression
OR	Odds Ratio
PHQ – 9	Patient Health Questionnaire -9
PHQ – 15	Patient Health Questionnaire -15
SAS	Statistical Analysis System
SSS -8	Somatic Symptom Scale - 8
USUHS	Uniformed Services University of the Health Sciences

Glossary

Active-Duty Service Member – An individual who is in full time employment with the military and can be deployed to combat at any time (Veterans Administration, 2012).

Anxiety – "An emotion characterized by feelings of tension, worried thoughts and physical changes" (American Psychological Association, 2022a).

Coping - The capacity to adapt successfully in the presence of risk and adversity

Depression – A medical illness that causes feelings of sadness, a loss of interest in activities, and/or a decrease in the ability to function within the environment (American Psychological Association, 2022b).

Environmental Stimuli – Any type of input from the environment that requires an individual to adapt. These stimuli can be either positive or negative. (Roy, 2011)

Military Culture – The moral beliefs, values, and professional characteristics within military organizations (Murray, 2019).

Somatic symptoms - Physical signs and symptoms that present in patients of all ages without a clear connection to a medical diagnosis (Haller, Cramer, Lauche, & Dobos, 2015).

Stigma – Cultural attitudes, behaviors, and policies that affect an individual from seeking care (Acosta et al., 2014).

Stress – "The feeling of being overwhelmed or unable to cope with mental or emotional pressure" (Mental Health Foundation, 2021).

CHAPTER 1: Introduction

Mental health is an ongoing concern within the United States as the overall prevalence of mental health conditions continues to increase (Mental Health America, 2021). There are a decreasing number of trained mental health care providers to meet the growing need, so many adults are turning to their primary care providers for mental health concerns (Arnaez, Krendl, McCormick, Chen, & Chomistek, 2020; Bekhuis, Schoevers, van Borkulo, Rosmalen, & Boschloo, 2015; Löwe et al., 2008). Many patients who seek mental health services present with somatic symptoms, signs and symptoms that cannot be clearly connected to a medical diagnosis, but which have been associated with mental health disorders like anxiety and depression. (Haller, Cramer, Lauche, & Dobos, 2015). Adults with mental health conditions who experience somatic symptoms use more health care services than adults without mental health concerns (Gierk et al., 2014).

Members of the U.S. Military have an increased risk for mental distress due to stressors associated with the military lifestyle, such as military deployment and geographic separation from family members (Donoho, Riviere, & Adler, 2017). Somatic symptoms are also common in active-duty service members, being the fifth leading cause of outpatient visits between 2017 and 2022 (Department of Defense, Armed Forces Health Surveillance Division, 2020). When service members leave their workplace to seek medical care for somatic symptoms, health care costs rise and unit readiness declines (Burton, Farley, & Rhea, 2009; de Burgh, White, Fear, & Iversen, 2011; Padden, Connors, & Agazio, 2011). There is some literature in civilian communities, but few researchers have explored the relationship between somatic symptoms and mental health complaints in active-duty military service members. If a relationship between somatic symptoms and mental health disorders such as anxiety and depression is identified in active-duty service

members, new policies and practices can be developed to improve well-being, decrease healthcare costs, and increase military readiness.

The Department of Defense began deploying periodic (every 3-4 years) Health Related Behavior Surveys in 1989 in an ongoing effort to provide information on the wellbeing of Service members. The 2015 HRBS was administered to a selected population of active-duty service members between November 2015 to April 2016, and results were made public in June 2018. This survey examined several health-related behaviors, including somatic symptoms, anxiety, and depression (Meadows et al., 2018). The 2018 HRBS, administered between October 2018 and March 2019, did not include questions about anxiety and depression (Meadows et al., 2021). Therefore, as the goal of this study is to examine relationships between somatic symptoms, anxiety and depression, only data from the 2015 HRBS will be used in this analysis.

This chapter provides an overview of the background of somatic symptoms, anxiety, and depression in civilian and military populations, including demographic factors that may influence these conditions. This chapter also provides a review of the nursing theory that informed this research, the study purpose, specific aims, approach, significance, and assumptions.

Background

Somatic symptoms are related to feelings of distress, a decrease in overall wellness, and an increase in the use of health care services in patients throughout the world (Beutel et al., 2018; Löwe et al., 2008). Research conducted in China and Japan noted that adults of all ages experience somatic symptoms which they report disrupt their daily life (Nakao, Yamanaka, & Kuboki, 2001 Nakao, & Yano, 2006; Wong, & Fong, 2015; Yu et al., 2019). In Great Britain, the most common reasons people seek outpatient care is to address somatic symptoms (Matalon, Kotliroff, Blumberg, Yaphe, & Kitai, 2011). Research conducted in Canada revealed that in one

year an estimated 1.3 million Canadian adults sought health care for a somatic symptom (Park & Gilmour, 2017). In the United States, somatic symptoms are an underlying cause for 40 to 50 percent of all civilian primary care visits (Hanssen, Finch, & Rosmalen, 2021; Haller, Cramer, Lauche, & Dobos, 2015). These studies highlight the wide prevalence of somatic symptoms and their impact on healthcare utilization across the globe.

Somatic Symptoms and Mental Health

Patients who report high levels of stress also report high levels of anxiety and somatic symptom severity (Burton, Farley, & Rhea, 2009; Wong & Fong, 2015). Somatic symptom severity has been shown to impact how anxiety manifests in adult patients (Han et al., 2014; Romera, et al., 2010; Hoge et al., 2006). There is a linear association between the number of somatic symptoms and the severity of anxiety and depression symptoms (Haug, Mykletun, & Dahl, 2004), and somatic symptoms are also significantly correlated to depression (DeArmond, Stallones, Chen, & Sinteck, 2006; Dijkstra-Kersten et al., 2015; Jat et al., 2022; Zhou et al., 2011). Most concerning, the higher the symptom severity the worse the treatment outcomes for patients with depression (Han et al., 2014; Jat et al., 2022). These studies provide foundational evidence suggesting a significant relationship between somatic symptoms, anxiety, and depression.

Impact of Somatic Symptoms on the Active-Duty Military Population

Active duty service members frequently report experiencing somatic symptoms. Between 2016 and 2021, “signs, symptoms, and ill-defined conditions” were the fifth leading cause of outpatient visits for active-duty service members, accounting for 1.2 million outpatient visits in 2020 (Armed Forces Health Surveillance Branch, 2017, 2018, 2019, 2020, 2022). Over thirty-seven percent of active-duty service members who deployed in the past three years reported high

somatic symptom burden, but the prevalence appears to vary by military branch, age, gender, and rank. Headaches are the most reported somatic symptom across all services. Army and Marine Corps members have the highest prevalence overall, with Army members being the most likely to report physical symptoms. Symptoms increased with age and enlisted service members reported more symptoms than officers and women were more likely to report somatic symptoms than men. While the overall prevalence of somatic symptoms did not vary by ethnicity, non-Hispanic white and black service members reported higher symptoms severity compared to other ethnic groups (Meadows et al., 2018). These data show that somatic symptoms are highly prevalent throughout the active-duty military population.

Impact of Mental Health Disorders on Global Healthcare

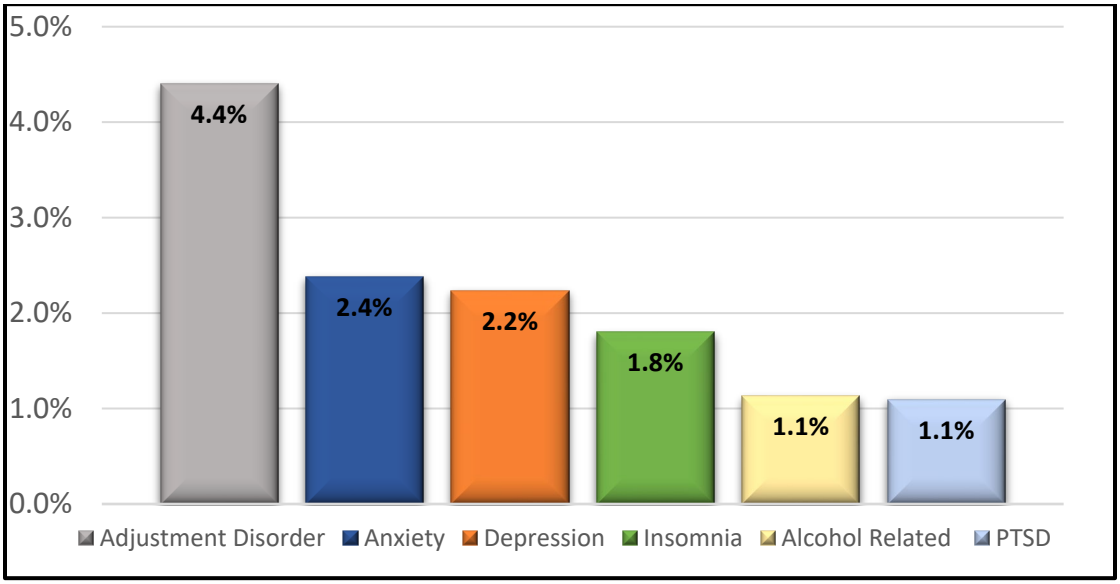
Mental health disorders place a burden on global healthcare systems and negatively impact the social and economic well-being of communities around the world. Anxiety and depression are two of the leading mental health diagnoses in the world (World Health Organization, 2017), and in the United States (Centers for Disease Control, 2019). Over 11 percent of adults in the United States experience "feelings of worry, nervousness, or anxiety" (Centers for Disease Control [CDC], 2020), and more than 10 percent of outpatient visits and 11 percent of emergency room visits in the United States are related to feelings of depression (CDC, 2019). The growing number of mental health issues is creating strain on healthcare systems, as there are not enough mental health providers to meet the demand (Holiday, Hepner, & Pincus, 2022).

Impact of Mental Health on the Active-Duty Military Population

The military population is also experiencing an increase in the utilization of mental health services. More than 2 million active-duty service members sought mental health care services in

2020, making this condition the third leading cause of outpatient visits overall. In the 5 years leading up to 2020, mental health disorders were also the leading cause of hospital admissions for active-duty service members (Armed Forces Health Surveillance Branch, 2020). As shown in Figure 1, the Defense Health Agency's Psychological Health Center of Excellence reported that anxiety and depression were the leading mental health diagnoses in the United States military, second only to adjustment disorder in 2019 (Defense Health Agency, 2021). The results from the 2015 DoD HRBS also showed that the prevalence of anxiety and depression symptoms varied greatly by branch of Service, pay grade, gender, age, and ethnicity. The 2015 HRBS did not include an analysis of the prevalence of anxiety, depression, and somatic symptoms by diagnostic severity. Nor did the results show the relationship between these variables (Meadows et al., 2018). Further research is needed to examine the full impact of demographic factors on the presentation of anxiety and depression.

Figure 1: Incidence of Diagnosed Mental Health Conditions in All Branches of the US Military in 2019*



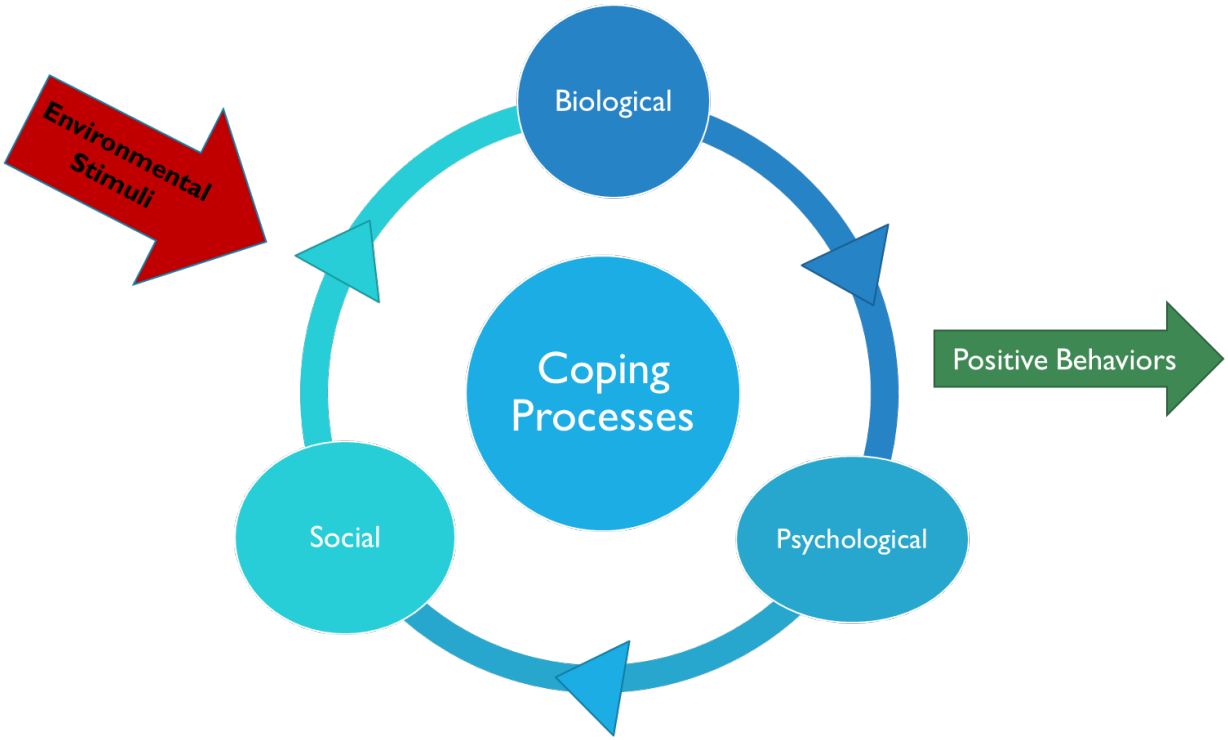
*Data from the Defense Health Agency Psychological Health Center of Excellence (2021)

Theoretical Framework: Roy's Theory of Adaptation

The WHO (2022) defines health as a state of well-being that involves the biological, psychological, and social elements of all individuals. Callista Roy's Theory of Adaptation provides a conceptual framework that outlines how the relationship between these elements of health impact health outcomes. Roy asserts that each individual's health is comprised of a state of balance between the biological, psychological, and social elements of individuals and their environment. This state of balance occurs through adaptation, which does not mean that the individual is free of disease, but that each individual is unique and define their own sense of well-being (Roy, 2013). For example, in an aging population, adaptation can mean that the individual is able to function independently (Salazar-Barajas, Salazar-Gonzalez, & Gallegos-Cabriales, 2017) while in people with a terminal illness, adaptation can mean an absence of fear and social support throughout the end of life (Roy, 2011).

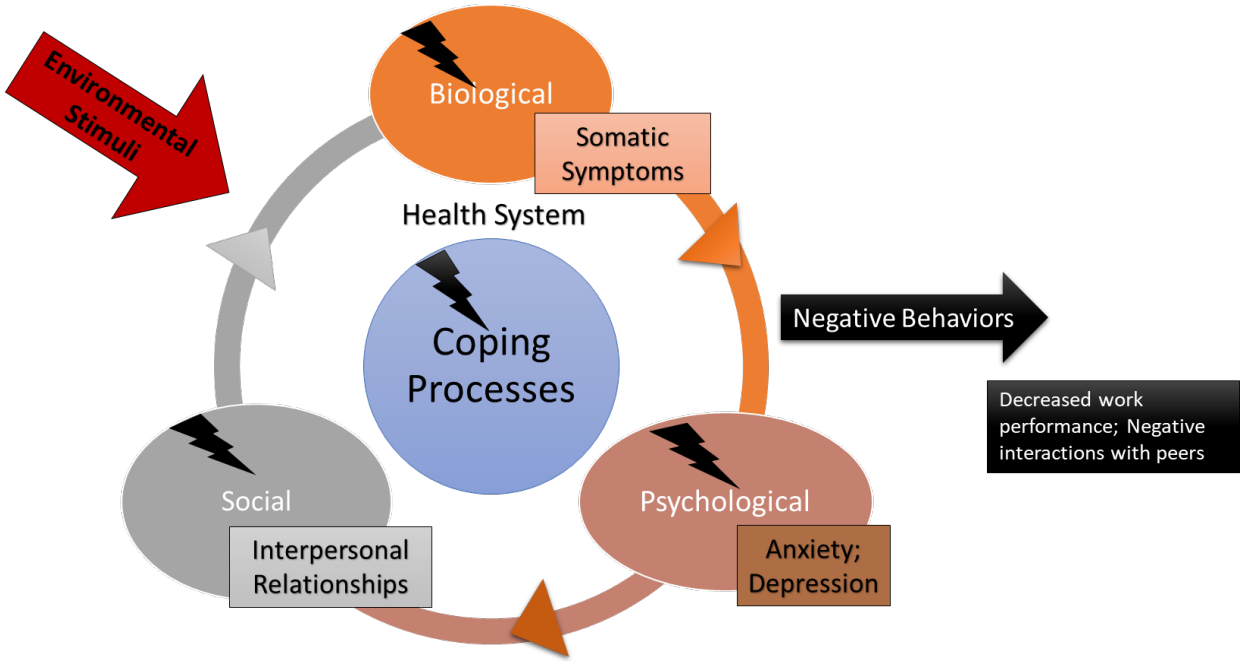
There are three different levels of adaptation: integrated life processes, compensatory life processes, and compromised life processes. The levels of adaptation have varying impacts on the health of individuals. The first level of adaptation is integrated life processes. Within this level of adaptation, the individual is not experiencing disrupting environmental stimuli, and the individual's biological, psychological, and social elements are in a state of balance. As a result, the individual engages in positive life behaviors, such as healthy interpersonal relationships. The level of adaptation shifts to compensatory life processes when disruptive environmental stimuli are introduced. Within this level of adaptation, the individual must use coping processes to reestablish balance between all elements of their health and the environment, which results in positive life behaviors (Roy, 2013) (Figure 2).

Figure 2: Theory of Adaptation Compensatory Life Processes



Compromised life processes occur when disruptive stimuli appear, but the individual's coping processes have failed. As a result, the individual begins to experience breakdowns in the health system (Roy, 2013). The breakdown in health can present in varying ways. For example, the imbalance in the biological elements of an individual may present as somatic symptoms, while the imbalance in the psychological elements of an individual may present as anxiety or depression. Furthermore, the imbalance in the social elements may present as a breakdown in interpersonal relationships. These breakdowns in health can lead to negative behaviors, such as decreased work performance or negative interactions with peers (Meredith et al., 2011). (Figure 3)

Figure 3: Compromised Life Processes



Roy (2013) identified that there are three types of stimuli that can disrupt an individual's health system: focal, contextual, and residual. Focal stimuli, such as a stressful work environment, are stimuli that immediately interrupt the biopsychosocial processes in the individual. Contextual stimuli are internal and external factors that affect how the focal stimuli are interpreted by the individual. Examples of contextual stimuli include interpersonal relationships and financial resources. The residual stimuli are outside factors that have an unclear relationship to the focal stimuli, such as culture, age, and gender.

Nurses play a critical role in working with individuals to reestablish an integrated or compensatory life process. The nurse must first identify the stimuli and the ways the stimuli has affected the individual's biological, psychological, and social processes. Next, the nurse must identify the adaptive level the individual, and the level of nursing care needed. This assessment allows the nurse to develop a treatment plan that will include interventions to target either the

focal stimuli or behaviors that can reduce the impact of the focal stimuli. These actions allow the nurse to help the patient reach a new level of adaptation (Roy, 2011).

Roy's Adaptation Model and Active-Duty Service Members

Active-duty service members experience an ongoing combination of focal, contextual, and residual stimuli. The focal stimuli of the active-duty service member differ from the general population. Active-duty service members work in environments where they are continually exposed to physical danger through combat operations and trainings. Service members' home environments frequently change, due to military reassignments. The service member's contextual stimuli are like those of the general population. Active-duty service members experience interpersonal issues and financial strain, which are often worsened due to the general stress of the military lifestyle (Donoho, Riviere, & Adler, 2017). Elements of the residual stimuli within the military environment include factors such as age, gender, and education. The military population is younger and has a higher percentage of males compared to the general population. The education of the military population varies throughout the enlisted and commissioned officer population (Meadows et al., 2018). Culture is the most significant difference between the residual stimuli of the civilian and military populations. The military environment has a unique culture, which impacts how the active-duty service member copes with environmental stimuli (Westphal & Convoy, 2015).

The foundation of the military culture is its unique value system, called the military ethos. The military ethos is taught to service members across the varying branches and throughout all career types. The military ethos prioritizes actions such as altruism, fidelity to the military mission, physical and mental strength, and professional excellence. These values encourage the service member to place the military mission first and to "endure hardships

without complaint". These values are a source of strength for many service members, but aspects of the military ethos, such as the over emphasis of fidelity to the military mission and physical and mental strength, have become a barrier in the overall health and wellness of some (Westphal & Convoy, 2015).

Military culture places a high value on physical health, as physical fitness has a direct impact on the service member's ability to complete the military mission. Military culture is not tolerant of mental health disorders, nor does it reward help seeking behaviors in the mental health arena. Service members who seek mental health care have reported feelings of stigma while in treatment, and others have expressed a fear of being stigmatized and/or rejected by their peers, which prevented them from seeking mental health care when they experienced symptoms. Service members identified that the stigma was associated with the perception that they were unable to handle hardships or that they had failed in their military mission. Some expressed concerns about the long term impact a mental health diagnosis might have on their military career. The stigma associated with seeking treatment for mental health concerns has secondary consequences as well. Some service members manage symptoms through substance or alcohol abuse, and others may attempt suicide, both of which culminate in significant negative outcomes for the individual service member and increase healthcare and training costs for the Military (Acosta et al., 2014).

The military culture is a source of strength for many service members who succeed in the military culture by adopting healthy coping skills, (Meredith et al., 2011; Westphal & Convoy, 2015). However, many active-duty service members cannot find or use healthy coping mechanisms needed to maintain a healthy mind and body. These service members may be more at risk for experiencing somatic symptoms, anxiety, and depression and who need support to

adapt to military stressors (Gantz et al., 2020; Meredith et al., 2011). Based on Roy's Theory of Adaptation, somatic symptoms, anxiety, and depression are indicators that an individual has entered a compromised life process because they have failed to adapt (Roy, 2013).

Statement of Problem

The military culture presents a unique challenge for active-duty service members seeking help when their health system is disrupted. The military culture and value system places greater emphasis on physical fitness. As a result, service members are more likely to seek care for physical health needs (Acosta et al., 2015; Westphal & Convoy, 2015). A somatic symptom may be the first presentation of a mental health issue within the active-duty service member population.

Purpose of the Study

The purpose of this study is to examine the relationship between somatic symptoms, anxiety, and depression in the DoD active-duty military population. These results can inform effective assessment and treatment of anxiety and depression. This study will also examine whether demographic variables such as age, rank, and branch of Service, impact the relationship between somatic symptoms, anxiety, and depression.

Most current studies on somatic symptoms and mental health have been done within international cultures in civilian populations, and studies done within the military have focused on individuals with post-traumatic stress disorder or suicide (Peterson, 2022; Shim et al., 2020; St. Cyr, McIntyre-Smith, Contractor, Elhai, & Richardson, 2014). There is a significant gap in the literature. Cultural factors have been found to influence the relationship between somatic symptoms, anxiety, and depression (Hoge et al., 2006; Wong & Fong, 2015). Identifying the relationship between somatic symptoms, anxiety, and depression in an active-duty population,

and examining the impact of individual demographic factors, is important to improve the well-being of active-duty service members, enhance military readiness, and decrease demand on the Military Health System.

Specific Aims

This study proposes three specific aims:

Specific Aim 1

1.a. To examine the overall prevalence of somatic symptoms, anxiety, and depression by the screening severity level within active-duty service members who participated in the 2015 HRBS using reported SSS-8, GAD-7, and PHQ-9 scores.

1.b. To examine the prevalence of different mental health indicators [probable GAD (yes/no) and probable depression (yes/no) grouped into one multinomial variable, mental health indicators (none, probable anxiety only, probable depression only, and presence of both anxiety and depression] within active-duty service members who participated in the 2015 by using reported GAD-7 and PHQ-9 severity level scores.

1.c. To examine the prevalence of different somatic symptoms [stomach or bowel problems (yes/no); back pain (yes/no); pain in arms; legs, or joints (yes/no); headaches (yes/no); chest pain or shortness of breath (yes/no); dizziness (yes/no); Feeling tired or having low energy (yes/no); trouble sleeping (yes/no)] among active-duty service members participated in the 2015 HRBS using reported SSS-8 scores.

1.d. To complete a subgroup analysis of the weighted prevalence of somatic symptoms, anxiety, depression, and different mental health indicators within the study populations by the following subgroups: branch of Service, pay grade, gender, age, ethnicity.

Hypothesis: The overall prevalence of somatic symptoms, anxiety, and depression screening severity level will be significantly different based on branch of Service, rank, gender, age, and ethnicity.

Specific Aim 2

To determine if branch of Service, pay grade, gender, age, and ethnicity influence the severity of anxiety, depression, and somatic symptoms within active-duty service members who participated in the 2015 HRBS using reported SSS-8, GAD-7, and PHQ-9 scores.

Hypothesis: Individual demographic factors will affect the diagnostic severity of somatic symptoms, anxiety, and depression.

Specific Aim 3

To determine if an increase in somatic symptom severity scores (using reported SSS -8 scores) is associated with an increase in anxiety and depression scores within active-duty service members who participated in the 2015 HRBS using reported GAD-7 and PHQ-9 scores.

Hypothesis: Somatic symptom severity will affect the severity of anxiety and depression.

Research Questions

This study seeks to answer the following research questions:

- How prevalent are somatic symptoms, anxiety, and depression by diagnostic severity within active-duty service members?
- Do demographic factors influence the prevalence of somatic symptoms, anxiety, and depression diagnostic severity within active-duty service members?

- Do demographic factors influence the diagnostic severity of somatic symptoms, anxiety, and depression in active-duty service members?
- Does somatic symptom diagnostic severity influence the diagnostic severity of anxiety and depression in active-duty service members?

The central hypothesis for this study is that increases in somatic symptoms are directly associated with an increase in anxiety and depression symptoms in active-duty service members.

Approach

This study presents an original secondary data analysis of cross sectional data collected from service members who participated in the DoD funded 2015 Health Related Behaviors Survey (HRBS). The HRBS is a cross-sectional survey used by the DoD to examine the health, health-related behaviors, and well-being of service members. The 2015 HRBS were administered by the RAND Corporation to non-deployed active-duty service members across military branches from November 2015 to April 2016. The content of the survey included questions on mental health indicators, physical symptoms, branch of service, gender, pay grade, age group, race/ethnicity, and educational level. The DoD publicly released these data, and no individual identifiers were provided (Meadows et al., 2018).

The HRBS researchers incorporated self- reported health screening questionnaires into the 2015 survey to assess for somatic symptoms. The HRBS researchers measured the presence of somatic symptoms through the Somatic Symptom Scale-8 (SSS-8), an eight-question symptom checklist. A SSS-8 value greater than or equal to eight was classified as high somatic symptom severity. The SSS-8 surveyed the following eight physical symptoms: stomach or bowel problems; back pain, pain in arms; legs, or joints; headaches; chest pain or shortness of breath; and dizziness, fatigue, or sleep troubles (Meadows et al., 2018)

The HRBS researchers used the Generalized Anxiety Disorder – 7 (GAD-7) and Patient Health Questionnaire-9 (PHQ-9) to assess symptoms of depression and anxiety in the 2015 survey (Meadows et al., 2018). These questionnaires were not used in the 2018 HRBS (Meadows et al., 2021). The GAD-7 consists of seven questions related to common anxiety symptoms, such as feelings of fear, annoyance, and irritability (Löwe et al., 2008; Spitzer et al., 2006). A GAD-7 value greater than or equal to 10 was classified as probable generalized anxiety disorder (Meadows et al., 2018). The PHQ-9 assesses symptoms of depression. The PHQ-9 consists of nine questions that address possible symptoms of depression, to include sleep patterns, energy levels, and eating habits (Kroenke, Spitzer, and Williams, 2001). A PHQ-9 value greater than or equal to 15 is classified as probable depression (Meadows et al., 2018).

Analysis of data will be conducted using the SAS 9.4 software package. Weighted prevalence estimates and 95% confidence intervals will be provided to summarize somatic symptoms, anxiety, and depression within the survey population. A subgroup analysis (unadjusted analysis) of the weighted prevalence of somatic symptoms, anxiety, and depression will also be conducted within the study populations by social and sociodemographic and military characteristics. An adjusted multinomial logistic regression model will be used to assess association between somatic symptoms and mental health indicators (none, probable anxiety only, probable depression only, and presence of both anxiety and depression) controlling for sociodemographic and military characteristics.

Significance of the Study

These results of this study are expected to identify specific somatic symptoms that are significantly associated to anxiety and depression, which can provide healthcare providers with additional risk factors to aid in the diagnosis and treatment of active-duty service members

suffering from a mental health disorder. This analysis can assist with developing more targeted coping mechanisms and preventative behavioral health care for active-duty personnel based on demographic factors such as branch of service, pay grade, age, race, and gender. Preventative behavioral health care and focused mental health assessments can decrease the long-term costs and impact of mental health to the DoD, Military Health System, and the service member.

Assumptions

The theoretical approach of this study presents three main assumptions.

1) An individual's health consists of a system of interacting parts.
2) The environment can impact an individual's health system through focal, contextual, and residual stimuli.
3) An individual's health status can impact behavior. (Roy, 1988)

Limitations

There are several limitations associated with a secondary data analysis. The primary limitation is that the original data were gathered to address the research questions and hypothesis of the original investigator. As a result, the secondary analysis does not have the ability to control the selection of study participants and the inclusion and exclusion criteria. The lack of oversight of the inclusion and exclusion criteria will also impact the population size of the study. The combined effect of these factors may impact the results of the research question and hypothesis of this study (Hien et al., 2015).

The secondary limitation is associated with sample size of the surveyed population. This study includes a subgroup analysis. This analysis will provide a greater understanding of the variability of somatic symptoms, anxiety, and depression within the varying subgroups, such as

gender, age, and military rank. The lack of control of the population size may result in a limited understanding of these variances (Hien et al., 2015).

The use of self-reported health related survey data also presents a unique limitation. There is the risk that participants in these studies may minimize the reported symptoms in order to present a culturally desirable response, such as a higher state of health or mental well-being. This can be mitigated by ensuring that the study includes a representative sample; yet the 2015 HRBS reported a low response rate. The reported data may be impacted by a negative bias, as some of the study population may have engaged with the study due to frustrations with the Military Health System. As a result of this bias, these participants may report more negative symptoms. The combined impact could create an over or underestimation of the relationship between the study variables (Beckham et al., 2021; Meadows et al., 2018). Despite these limitations, the results will increase the scientific knowledge about the study variables within the active-duty service member population and identify areas for future research.

Conclusion

The high prevalence of somatic symptoms places a great burden on the worldwide healthcare system. Somatic symptoms are directly associated with increased mental health distress and increased health care utilization. A high number of active-duty Service members engage in care due to somatic symptoms and mental health issues. Anxiety and depression are two of the most prevalent mental health diagnoses in the United States active-duty population. Somatic symptoms, anxiety, and depression increase health care costs in the military population and decrease military readiness. There is a critical need to identify the relationship between somatic symptoms, anxiety, and depression within the active-duty service members working in the United States Department of Defense. Identification of demographic factors associated with

the severity of, and relationship between, somatic symptoms, anxiety and depression can inform tailored, culturally sensitive interventions. Further, knowledge gained from this study will help Military Health System providers identify risk factors that guide the early diagnosis of mental health disorders in active-duty Service members.

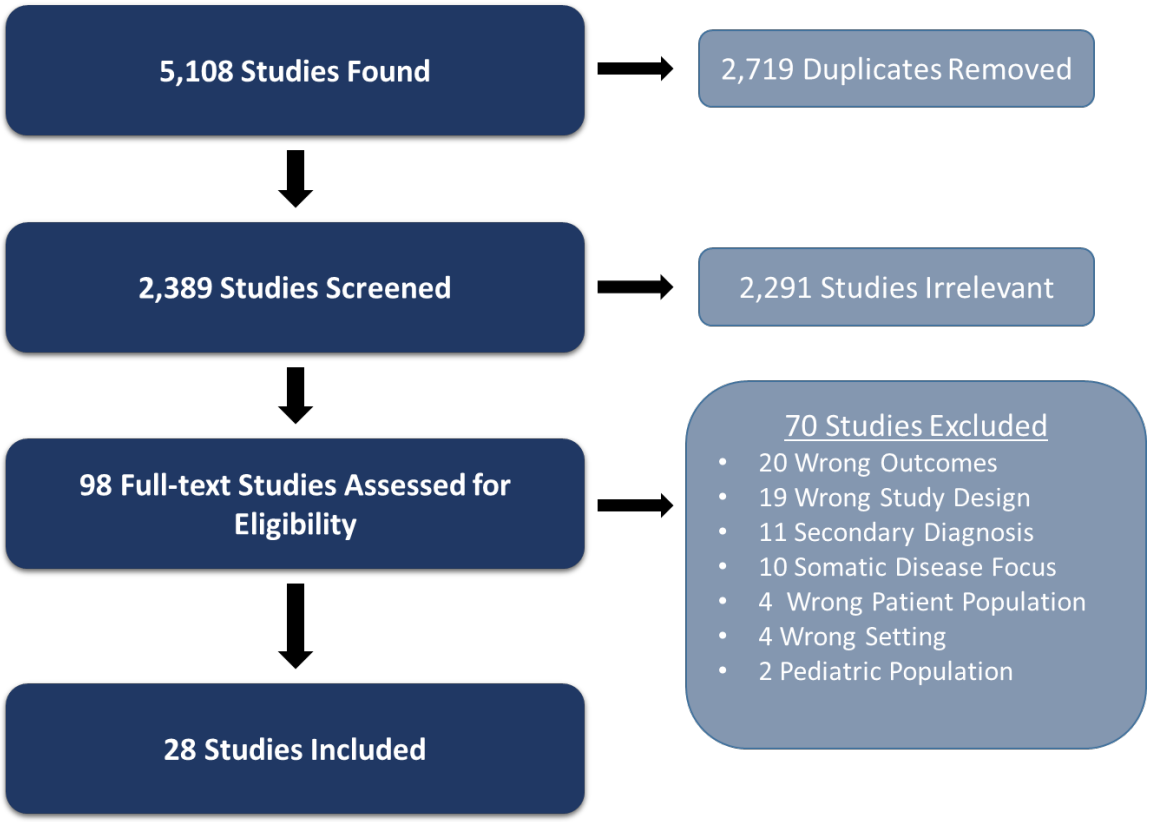
CHAPTER 2: Review of Literature

There is growing evidence documenting the relationship between somatic symptoms, anxiety, and depression in adult patients around the world (Simon, VonKorff, Piccinelli, Fullerton, & Ormel, 1999; Wong & Fong, 2015). Somatic symptoms are directly associated with increased mental health distress, such as anxiety and depression, and increased health care utilization in adult patients (Gierk et al., 2014). Some studies identified that somatic symptoms may be used as an indicator to predict a future mental health diagnosis (Aoki et al., 2012; Nakao, & Yano, 2006; Nakao & Yano, 2003). For the past five years, somatic symptoms were the fifth leading cause of outpatient visits for active-duty service members (Armed Forces Health Surveillance Branch, 2020). While the literature highlights the relationship between culture, gender, and age in the presentation of somatic symptoms, anxiety, and depression, there are limited studies on the relationship between somatic symptoms and mental health within the military population.

The purpose of this review is to present current research on the relationship between somatic symptoms, anxiety, and depression in adults across the world. This review will also present research on the demographic influences on the prevalence of these conditions. This review utilized research articles from 1990 to July 2022 retrieved from the PubMed, Embase, CINAHL and PsycINFO databases. These dates were selected to provide a historical understanding on the presentation of somatic symptoms in adults with anxiety and depression, as somatic symptom assessment tools were developed in the 1990s (Gierk et al., 2014). Literature searches included specific key terms related to somatic symptoms, depression, and anxiety within adults, regardless of military status, gender, ethnicity, or age range (see Appendix A). All included studies focused on the presentation of somatic symptoms in adults worldwide,

regardless of gender or ethnicity. Mental health studies included somatic symptoms in patients presenting with symptoms of stress, anxiety, and depression. Studies that focused on depression or anxiety in association with other major diagnoses, such as bipolar disorder, schizophrenia, cancer, or heart disease, were excluded. A total of 5,108 studies were identified from the searches, of which 2,719 duplicates were removed. The remaining 2,389 study titles and abstracts were reviewed, and 2,291 were found to be irrelevant due to wrong outcome, wrong study design, inclusion of complicating medical diagnoses, or publication credibility. The remaining 98 studies were screened, and 20 were excluded due to a weighted focus on the wrong outcome measurement, such as focusing on migraine pain rather than headaches and somatic symptoms. Another 19 studies were excluded due to the wrong study design, such as the testing the efficacy of specific drug treatments on patients with depression; 11 studies were excluded due to the inclusion of a secondary diagnosis; 10 studies were excluded due to their focus on somatic disease processes. The remaining studies were excluded due to the wrong population, such as pediatrics or elderly, or the wrong study setting, such as patients hospitalized for a mental health disorder. This resulted in 28 studies included for analysis. (Figure 4).

Figure 4: PRISMA Flow Diagram



This chapter presents a summary of key clinical research studies on somatic symptoms, anxiety, and depression and a review and analysis of the study methodologies, limitations, and key conclusions. Next, this chapter presents an overview of the background of somatic symptoms, anxiety, and depression, and existing literature on the relationship between somatic symptoms, stress, anxiety, and depression in adults. Finally, this chapter will address the gaps in the current literature, and the ways in which this research study can help fill these gaps.

Background

Somatic Symptoms

As highlighted in chapter 1, somatic symptoms are physical signs and symptoms that present in patients of all ages without a clear connection to a medical diagnosis (Haller, Cramer, Lauche, & Dobos, 2015). There is not a medical exam that screens for somatic symptoms.

Somatic symptoms are based on the patient's experience, and medical providers rely on varying self-report questionnaires to determine the presence of somatic symptoms. Researchers used over 40 different somatic symptoms questionnaires. Though there are variances in these questionnaires, all ask about the same general symptoms: cardiopulmonary, dizziness and fainting, gastrointestinal, musculoskeletal, and general feelings of malaise (Zijlema et al., 2013). The PHQ - 15 had one of the highest reliability scores compared to other somatic symptom questionnaires. The Somatic Symptom Scale - 8 (SSS-8) was developed from the PHQ-15 questions. The SSS-8 is a shortened alternative to the PHQ -15. The SSS-8 also has good reliability for use as to assess somatic burden in adult patients (Cronbach $\alpha = 0.81$) (Gierk et al., 2014). Responses to the SSS-8 can provide insight into the impact of somatic symptoms on individuals.

Anxiety

The American Psychological Association defines anxiety as "an emotion characterized by feelings of tension, worried thoughts and physical changes" (American Psychological Association, 2022a). Many patients with anxiety often experience physical symptoms, such as heart palpitations and shortness of breath, which can cause providers to misdiagnose the underlying anxiety issues. For this reason, the assessment and diagnosis of anxiety symptoms is similar to the assessment and diagnosis of somatic symptoms. Medical providers rely on self-report questionnaires. (Locke, Kirst, & Shultz, 2015). The Society for Clinical Psychology (2016) found that there are over 10 different anxiety questionnaires in use. A commonly used tool in the United States is the GAD-7 (Locke, Kirst, & Shultz, 2015). The GAD-7 provides a brief questionnaire with good reliability and validity (Cronbach $\alpha = 0.89$) for use in clinical and research settings (Spitzer et al., 2006).

HRBS researchers found that the GAD-7 highlighted the most common anxiety symptoms. The 2015 HRBS survey participants with a GAD -7 score of 10 or greater were characterized as having "probable GAD". Approximately 14 percent of the study's participants were categorized as having "probable GAD". As shown in the table below, the prevalence of probable GAD varied greatly by branch of Service, pay grade, gender, age, and ethnicity (Meadows et al., 2018).

Table 1: Prevalence of Probable Anxiety by Military and Demographic Variables*

Military Service					
Air Force	*Army*	*Marine Corps*	*Navy*	*Coast Guard*	
6.8%	15.9%	19.2%	16.4%	8.4%	
Pay Grade					
E1-E4	*E5-E6*	*E7-E9*	*W1-W5*	*O1-O3*	*O4-O10*
16.7%	15.6%	13.3%	12.5%	7.1%	4.6%
Gender					
Male	13.6%		*Female*	17.8%	
Age					
17-24	*25-34*	*35-44*	*45 and over*		
16%	14%	13%	12%		
Ethnicity					
Non-Hispanic White	*Non-Hispanic Black*	*Hispanic*	*Non-Hispanic Asian*	*Other*	
13.8%	11.4%	15.6%	16.2%	17.5%	

*Data from the 2015 HRBS (Meadows et al., 2018)

Depression

The American Psychological Association defines depression as a medical illness that causes feelings of sadness, a loss of interest in activities, and/or a decrease in the ability to function within the environment (American Psychological Association, 2022b). Medical providers use both provider directed questionnaires, which require specialized training, and self-report questionnaires, to assess and diagnose depressive symptoms. Many self-report

questionnaires are used in clinical and research settings because the tool involve little to no training to complete (Smarr, K. & Keefer, 2011). Similar to the SSS-8 and GAD-7, the PHQ -9 provides a brief questionnaire to access depression severity with good reliability and validity for use in clinical and research settings (Cronbach α = 0.89) (American Psychological Association, 2020).

The 2015 HRBS survey participants completed the PHQ-9 to assess for common depressive symptoms. HRBS researchers found that the PHQ-9 was an effective brief screening tool to identify "probable depression". Probable depression was categorized as a PHQ-9 score of 15 or greater. Approximately 9 percent of the study's participants were categorized as having "probable depression". The prevalence of probable depression varied by branch of Service, pay grade, gender, age, and ethnicity (Table 2) (Meadows et al., 2018).

Table 2: Prevalence of Probable Depression by Military and Demographic Variables

Military Service					
Air Force	*Army*	*Marine Corps*	*Navy*	*Coast Guard*	
4.1%	11.0%	13.5%	10.1%	4.4%	
Pay Grade					
E1-E4	*E5-E6*	*E7-E9*	*W1-W5*	*O1-O3*	*O4-O10*
10.8%	11.2%	8.2%	6.4%	4.7%	2.5%
Gender					
Male	9.1%		*Female*	11.0%	
Age					
17-24	*25-34*	*35-44*	*45 and over*		
10.9%	8.9%	8.5%	9.8%		
Ethnicity					
Non-Hispanic White	*Non-Hispanic Black*	*Hispanic*	*Non-Hispanic Asian*	*Other*	
9.0%	8.2%	9.8%	8.0%	14.2%	

Data from the 2015 HRBS (Meadows et al., 2018)

Correlations between Somatic Symptom, Anxiety, and Depression Questionnaires

Researchers must rely on patient reports to determine the severity of somatic, anxiety, and depressive symptoms (Locke, Kirst, & Shultz, 2015; Zijlema et al., 2013; Smarr, K. & Keefer, 2011) Somatic, anxiety and depressive symptoms often overlap. Several studies also found that early research on the somatic symptoms informed the development of the assessment scales for depression and anxiety. Depression assessment scales include questions on specific somatic symptoms, such as tiredness and low energy levels. Anxiety assessment scales include questions related to elevated heart rate or dizziness. These studies further highlight the relationship between somatic symptoms, anxiety, and depression (Sugahara et al., 2004; Wong & Fong, 2015;).

Anxiety and Somatic Symptoms

Increased stress and anxiety have been found to lead to an increase in somatic symptoms (Burton, Farley & Rhea, 2009; Nomura et al., 2007). In the review of literature, only 4 of the 28 studies identified for analysis focused solely on the relationship between somatic symptoms and anxiety (Burton, Farley & Rhea, 2009; Hoge et al., 2006; Wong & Fong, 2015; Zhou et al., 2011; Nomura et al., 2007). Two of the four studies highlighted the relationship between stress, anxiety, and somatic symptoms (Burton, Farley & Rhea, 2009; Nomura et al., 2007). One of the four studies identified differences in the presentation of somatic symptoms based on culture, controlling for gender and ages (Hoge et al., 2006;Wong & Fong, 2015). Only one of the four studies discussed somatic symptoms and anxiety in the military population (Burton, Farley, & Rhea, 2009).

Stress can lead to the development of anxiety. Environmental stress is associated with both somatic symptoms and anxiety (Nomura et al., 2007; Wong & Fong, 2015). In 2006, a cross sectional study was conducted in 185 male Japanese office workers to examine the relationship

between job stress and somatic symptoms. The men, ranging between 21 to 66 years of age, were assessed during their annual physical. Office workers who reported high levels of stress also identified a high degree of somatic symptom severity. The Spearman rank order correlation coefficient showed that the number of somatic symptoms was positively associated with the degree of stress (p <0.001). Fatigue, sleep issues, shoulder stiffness, and back pain were among the most frequently reported symptoms. The finding of this study is limited because researchers did not examine the impact gender, age, and ethnicity had on the relationship between the study variables (Nomura et al., 2007).

One study investigated the relationship between somatic symptoms and stress in the military community. In 2005, 130 female military spouses were recruited from military communities in the mid-Atlantic region of the United States to assess the relationship between stress and somatic symptoms in military spouses with a spouse deployed to a combat zone. The investigators implemented a one-time survey of military spouses using the Perceived Stress Scale to examine feelings of stress and the PHQ-15 to assess the presentation of somatic symptoms. The investigators surveyed two groups of spouses. All 68 participants in the first group had a spouse deployed to a combat zone. The 62 participants in the second group did not have a deployed spouse and served as the control group for the study. The investigators used independent t-tests to compare the assessment scores of each group and Pearson correlation to analyze the relationship between the perceived stress scores and reports of somatic symptoms. Participants with a deployed spouse had higher scores related to stress and somatic symptoms compared to the control group ($p < 0.001$). Military spouses who reported high perceived stress scores had a higher degree of somatic symptom severity compared to military spouse who reported low perceived stress scores. Pearson correlation showed a positive correlation between the level of stress and somatic symptoms ($r = .87$, $p < .001$). The most commonly reported

symptoms included trouble sleeping, low energy, and back pain (Burton, Farley, & Rhea, 2009). These findings have limited applicability, as the study was comprised of only females and the investigators did not fully control for the gender, age, and ethnicity of participants. These findings may not be generalized among all genders or in active-duty military populations.

Another study examined the relationship between anxiety, stress, and somatic symptoms in a single culture. In 2013, 202 male and female Chinese individuals living in Hong Kong were recruited to examine the relationship between stress, anxiety, and somatic symptoms. These individuals were surveyed using the used the Perceived Stress Scale, the PHQ-15, and the Hospital Anxiety and Depression Scale. The investigators used structural equation models to analyze the relationship between mental health disease processes and somatic symptoms, adjusting for sociodemographic variables, to include age, gender, education, and employment status. There was a direct relationship between somatic symptoms, stress, and anxiety ($Z = 4.328$, $p < 0.001$). Additionally, there was a direct relationship between somatic symptoms, anxiety, and depression ($Z = -1.931$, $p = 0.054$). Somatic symptoms increased as mental health symptoms increased. These findings further support the hypothesis that somatic symptoms increase with increased feelings of stress and anxiety and highlight the connection between somatic symptoms, anxiety, and depression (Wong & Fong, 2015). This study was conducted with in a single culture, and many not be generalizable to a population in the United States. Overall, these findings suggest that culture may impact the relationship between somatic symptoms and anxiety.

There is a broad difference in the presentation of anxiety across cultures, particularly Asian cultures compared to Western cultures. Many Asian cultures have stigmatized mental illness leading patients to minimize the psychological symptoms and focus more on the somatic symptoms. (Hoge et al., 2006; Wong & Fong, 2015; Zhou et al., 2011). In 2006, investigators

examined the differences in somatic symptoms in 30 male and female patients being treated at Tribhuvan University Teaching Hospital in Kathmandu, Nepal and 23 male and female patients being treated at the Center for Anxiety and Traumatic Stress Disorders Research Program at the Massachusetts General Hospital in Boston, Massachusetts. All participants completed the Beck Anxiety Inventory, and group scores were compared two-sided *t* tests. Linear regression analyses were also used to adjust for age and gender, with a statistical significance *p* value of 0.05. All study participants experienced somatic symptoms. However, somatic symptoms were higher (β= 2.88, t=2.18, p=0.03) and psychological symptoms were lower (β= -2.44, t=-2.31, p=0.03) for Nepali participants compared to American participants. For example, Nepal participants scored higher with specific somatic symptoms, such as dizziness, indigestion, and American participants scored higher on ability to relax or feeling restless. There was not a significant difference related to age or gender. The small sample size of the study may limit the accuracy of this finding (Hoge et al., 2006).

A 2011 study, conducted in Toronto, Canada and Changsha, China, included two different cultures to examine the relationship between culture, somatic symptoms, and anxiety. The two groups of study participants, (Chinese participants = 154; Euro-Canadian participants = 79) completed self-report psychometric tools to assess anxiety and somatic symptoms. Investigators used the analysis of covariance (ANCOVA) to analyze participant responses. Investigators found differences in the presentation of anxiety and somatic symptoms between the groups. Euro-Canadian participants had significantly higher levels of social anxiety, and Chinese participants had significantly higher levels of general feelings of worry. This study also found that Chinese participants had a statistically significant higher presentation of somatic symptoms compared to Euro-Canadian participants (p=0.05) (Zhou et al., 2011). These studies further

highlight the impact of culture on the presentation of anxiety and somatic symptoms in the varying populations.

The presented studies provide foundational information for healthcare providers treating adult patients with anxiety. Further research is needed to validate these findings across populations. Each of the study participant groups have very different characteristics, which limits the generalizability of these findings across the military population.

Depression and Somatic Symptoms

In the review of literature, 19 of the 28 studies identified for analysis highlight the relationship between somatic symptoms and depression. The focus of these studies fell into three categories: eight studies focused on the presentation of somatic symptoms in patients with depression (DeArmond, Stallones, Chen, & Sinteck, 2006; Grover et al., 2012; Jat et al., 2022; Taycan, Ozdemir, Erdogan-Taycan, & Jurcik, 2015; Terre et al., 2015; Vaccarino, Sills, Evans, & Kalali, 2008; Nakao, Yamanaka, & Kuboki, 2001; Zhao et al., 2018); five studies highlighted how culture influences the presentation of somatic symptoms in patients with depression (Arnault, Sakamoto, & Moriwaki, 2006; Dreher et al., 2017; Parker, Cheah, & Roy, 2001; Ryder et al., 2008; Simon et al., 1999); and six studies examined the predictive relationship between somatic symptoms and depression (Aoki et al., 2012; Dijkstra-Kersten et al., 2015: Nakao & Yano, 2006a; Nakao & Yano, 2006b; Nakao & Yano, 2003; Terre et al., 2003). None of the studies examined the relationship between somatic symptoms and depression in the military population.

Varying statistical analysis methods revealed a relationship between depression and somatic symptoms (DeArmond, Stallones, Chen, & Sinteck, 2006; Taycan, Ozdemir, Erdogan-Taycan, & Jurcik, 2015). Exploratory and confirmatory factor analyses revealed that depression symptoms generated a two factor model across genders, which included psychological symptoms

and physical symptoms in 709 adults residing in a Colorado farming community (DeArmond, Stallones, Chen, & Sinteck, 2006). Multiple linear regression revealed that depressive and somatic symptoms were positively associated in 90 adult patients at a Turkish hospital when controlling for age, gender, and education ($p < 0.001$) (Taycan, Ozdemir, Erdogan-Taycan, & Jurcik, 2015).

The prevalence of somatic symptoms increases with the severity of depression (Jat et al., 2022; Nakao, Yamanaka, & Kuboki, 2001). A descriptive, cross-sectional study with 140 participants in Pakistan used a Chi-square analysis to examine the relationship between somatic symptoms identified in the SSS-8 and a depressive disorder, to include mild, moderate, and severe depression. All somatic symptoms were significantly associated with any depressive disorder ($p< 0.05$). The prevalence of somatic symptoms increased with the severity of the depressive disorder (Jat et al., 2022). Investigators in Japan examined the association between somatic symptoms and depression severity in 91 adult patients being treated at the University of Tokyo Outpatient Clinic. ANCOVA was also used to compare the prevalence of different somatic symptoms based on the diagnosis severity and controlling for age. Results revealed that total reported somatic symptoms were greatest in patients with major depressive disorder ($p < 0.001$). The most frequently reported symptoms for these patients included "fatigue, insomnia, nausea/vomiting, and back pain" ($p < 0.05$) (Nakao, Yamanaka, & Kuboki, 2001). These studies revealed that there is a relationship between somatic symptom severity and depression severity.

Other evidence suggests that several types of somatic symptoms are directly related to a depressive disorder (Zhao et al., 2018; Vaccarino, Sills, Evans, & Kalali, 2008). A total of 2091 patients participated in a multicenter study across Canada and the United States to identify somatic symptoms associated with depression. Participants completed the Somatic Symptoms Inventory and the Hamilton Depression Rating Scale. Pearson correlation was conducted to

examine the relationship between the patient responses. Painful and non-painful somatic symptoms are often reported in patients with depressive disorder. Somatic systems that had the strongest relationship with major depressive disorder included: "feeling fatigued, weak, or tired all over" (r=0.05), general feelings of malaise (r=0.41), and feelings of weakness (r=0.41). Somatic symptoms increased as the severity of depression increased (r= 0.43). The study environment presented a significant limitation to the independence of this study, as the participants were recruited for a pharmaceutical clinical trial. The patient data were "restricted", and investigators were not able to control for sociodemographic variables. Despite this limitation, this study results demonstrate that understanding the relationship between specific somatic symptoms and depression can help providers better understand how depression presents in varying patients (Vaccarino, Sills, Evans, & Kalali, 2008). Investigators conducted a study in China and recruited 3516 adult patients receiving treatment for depression from 16 psychiatric hospitals and 16 general hospitals across the nation. The most prevalent somatic symptoms were insomnia, physical complaints, and weight loss (95% CI). Chi-square tests showed that the prevalence of somatic symptoms varied across different age groups ($\alpha = 0.05/3 = 0.0167$). Fisher's z-test revealed a possible variation between the presentations of somatic symptoms across genders (Zhao et al., 2018). This study suggests that there is a relationship between specific somatic symptoms and the severity of depression.

Results from studies in Japan and India revealed that there is an increased prevalence in the presentation of specific somatic symptoms across genders (Grover et al., 2012; Sugahara et al., 2004). Adult patients in a hospital in northern India with a diagnosis of depression presented at least one somatic symptom. The most prevalent somatic symptoms associated with depression in the study participants included low energy, trouble sleeping, and gastrointestinal upset. Investigators conducted a Chi-square analysis and revealed that female patients were more likely

to present with back pain ($\chi 2 = 5.7$; $p = 0.02$) or pain in the arms, legs, or joints ($\chi 2 = 3.9$; $p = 0.05$) compared to male patients (Grover et al., 2012). This study revealed a significant relationship between specific somatic symptoms, depression, and gender.

Investigators conducted a study in Japan to examine the major somatic and psychiatric symptoms associated with depression in male and females. The study was conducted in a Japanese urban hospital with 335 adult participants diagnosed with a depressive disorder and a control group of 425 participants who did not have a diagnosis of depression (n=425). Data were collected using varying psychological assessment tests, to include the international depression scale and a somatic symptom checklist. Investigators used logistic regression to assess demographic data and psychological assessments as well as somatic symptom checklists scores, adjusting for age and gender. Investigators did not find a difference in the prevalence of somatic symptoms across varying age groups. The findings suggest that the presentation of specific somatic symptoms varied by gender ($p = 0.01$). Males were more likely to have excessive sweating (odds ratio [OR] = 6.17), fatigue (OR = 4.27), and diarrhea (OR = 3.04). Females were more likely to report headache (OR = 7.31), sweating (OR = 4.04), and loss of appetite (OR = 5.96) (Sugahara et al., 2004). This study also highlighted important information on the gender difference related to the presentation of somatic symptoms in patients with depression.

These studies further highlight the relationship between somatic symptoms and mental health issues. The relationship between somatic symptoms and depression is clearly revealed across the studies through varying statistical methods. The varying locations of these studies presents a limitation to these findings, as findings may not be generalizable to a culturally diverse American population or the active-duty military community.

Culture, Depression, and Somatic Symptoms

Culture also impacts the prevalence of somatic symptom presentation in adults with depression (Arnault, Sakamoto, & Moriwaki, 2006; Dreher et al., 2017; Parker, Cheah, & Roy, 2001; Ryder et al., 2008; Simon et al., 1999). In 1991 through 1992, 25,916 patients across 15 primary care clinics located across 14 countries on 5 continents were screened for depression and somatic symptoms. Data were collected on depression and somatic symptom assessments from the World Health Organization medical database. Of those screened, 1,146 patients between the ages of 18 and 64 years were identified to have major depressive disorder. The investigators hypothesized that the presentation of somatic symptoms in patients diagnosed with depression vary by country of origin. In addition, it was hypothesized that the severity of somatic symptoms would vary based on the type of medical facility where the patient received care. Linear and logistic regression were used to compare the probability of somatic symptom presentation across different countries, revealing significant differences across the 14 medical centers ($p = 0.002$). The reporting of psychological symptoms varied by ethnicity and socioeconomic status. Patients with a high socioeconomic status and patients from Western cultures were more open to reporting psychological symptoms. Patients with depression who regularly sought care from a primary care clinic reported fewer somatic symptoms than patients who sought care at urgent care facilities. The limitation of this study is the variance in the type of assessment scales used by each country and the lack of consideration of cultural differences between the countries assessed. This study does provide foundational evidence that there are possible ethnic, geographic, and socioeconomic factors that impact the association of somatic symptoms and depression (Simon et al., 1999).

The somatization of depressive symptoms is highly prevalent in Asian adults compared to Western adults. A 2001 study conducted across Australia and China used chi-square to analyze

the difference in the presentation of somatic symptoms among Australian (n=50) and Chinese (n=50) adults with depression. The analysis showed that Chinese adults had a greater odds of reporting somatic symptoms associated with depression compared to the Australian adults ($p < 0.05$) (Parker, Cheah, & Roy, 2001). In 2005, 50 Japanese female students from Tokyo Women's University and 44 American female students from a Midwestern University participated in a study examining the impact of culture on the presentation of somatic symptoms in patients with depression. ANOVA showed that Japanese female students had a higher mean for all somatic symptoms compared to the American students (Arnault, Sakamoto, & Moriwaki, 2006). These study suggest that individuals from Asian cultures with depressive symptoms present with more somatic symptoms compared to Western individuals.

A 2007 study in Hunan, China and Toronto, Canada also demonstrated consistent findings related to culture and depression. Investigators examined the differences in the presentation of somatic symptoms in Chinese (n = 175) and Euro-Canadian (n = 107) patients between the ages of 18 -65 years old being treated in outpatient mental health clinics. The patients presented with three testing methods: a spontaneous problem report, structured clinical interview, and symptom questionnaire methods. Investigators used axis factor analysis to examine the correlations between the patients' reports. Chinese patients reported more somatic symptoms of depression compared with the Euro-Canadian patients. Euro-Canadians reported more of the psychological symptoms of depression (Ryder et al., 2008). Moreover, a 2016 study compared the presentation of somatic symptoms in 110 Vietnamese and 109 German patients seeking treatment for depression at German outpatient clinics. Multivariate ANCOVA revealed that Vietnamese patients reported a higher severity of somatic symptoms compared to German patients ($p < 0.001$) (Dreher et al., 2017). These studies highlighted significant culture based variations in the presentation of somatic symptoms in patients with depression.

Predictive Relationship between Somatic Symptoms and Depression

Somatic symptoms and depression have a bi-directional relationship. Somatic symptoms are seen before and after a depression diagnosis (Aoki et al., 2012; Nakao & Yano, 2006a; Nakao & Yano, 2006b; Nakao & Yano, 2003; Terre et al., 2003). Five years of data (1985 -1990) from the longitudinal health study in the United States were analyzed to examine if somatic symptom complaints would predict a future depression diagnosis in 464 adults. Pearson correlation between baseline depression and somatic symptom scores showed that women with somatic symptoms were more likely to be diagnosed with depression 5 years later women ($F = 7.968$, $p = 0.005$) (Terre et al., 2003). This was a ground-breaking finding that has implications for early treatment to prevent the onset of depression later in life.

In 2006 Nakao & Yano conducted two separate studies among Japanese adults examining the predictive relationship between somatic symptoms and depression. These studies examined Japanese adults during the nationally required annual physical exam. Patients were required to complete a self-assessment of somatic and psychological symptoms. Data were analyzed using multinomial logistic regression analysis. Both studies revealed that specific somatic symptoms were predictive of a future depression diagnosis in the following year (both $p < 0.05$). These two studies confirmed previous research of the predictive value of somatic symptoms and onset of depression. These studies also revealed that understanding the relationship between somatic symptoms and depression can have broad impacts on the identification of future depression diagnoses (Nakao & Yano, 2006a; Nakao & Yano, 2006b).

A retroactive study using data from the Netherlands Study of Depression and Anxiety examined if somatic symptoms, as measured by the 4 Dimensional Symptoms Questionnaire, could predict a subsequent diagnosis of both depression and anxiety over a four year time

period (2004 – 2007). Investigators assessed data from 611 male and female participants between the ages of 18 to 65 years without a diagnosis of depression or anxiety at the start of the study. The 2-year and 4-year follow-up data were reviewed to identify if the study participant received a new diagnosis of either disorder. Hazard ratios (HR) revealed that participants with a high level of somatic symptom severity had an increased the risk for a future diagnosis of both depression and anxiety (HR = 1.14; 95%CI = 1.10 to 1.17; $p < 0.001$) (Dijkstra-Kersten et al., 2015). This study showed the long lasting impacts between somatic symptoms and a future diagnosis of depression.

In 2011, a Japanese University hospital examined 284 patients between the ages of 18 and 46 with somatic complaints to determine if these patients would later present with depression. Study participants completed international psychological assessment tests and somatic symptoms checklists. Multiple linear regression was used to determine the predictive relationship between the assessments. Patients who reported 2-4 somatic symptoms in the initial annual physical were more likely to have a diagnosis of depression in the following year ($p < 0.05$). Chi-square tests revealed that specific somatic symptoms, such as headache and fatigue had a greater association with a future diagnosis of depression ($p < 0.05$) (Aiko et al., 2012). This study further highlighted the predictive relationship between somatic symptoms and depression.

The findings of these studies overall contributed to our knowledge about somatic symptoms and depression presenting later in individuals. These studies do present several limitations as they were focused on a single ethnic group, and the findings may not be generalizable to populations in other regions. Several studies used international psychiatric assessments that are not used within the United States, making it difficult to compare the

findings with American based studies (Aoki et al., 2012; Nakao & Yano, 2006a; Nakao & Yano, 2006b; Nakao & Yano, 2003). The presented studies provide a preliminary examination of the bi-directional relationship between somatic symptoms and depression and provide a foundation for future research on this relationship.

Anxiety, Depression, and Somatic Symptoms

Anxiety and depression are often co-occurring disorders. The presentation of somatic symptoms can vary when both diagnoses are present. In the review of literature, 3 of the 28 studies identified for analysis examined how somatic symptoms present in patients with both diagnoses (Haug, Mykletun, & Dahl, 2004; Romera et al., 2010; Zhu et al., 2012; Zhou et al., 2011). None of the studies examined the influence of culture on somatic symptom presentation, and none of the studies examined the relationship between somatic symptoms and co-occurring anxiety and depression in the military population.

Logistic regression analysis of 60,869 records of adults aged 20 years old and over from the 1997 health study of Nord-Trøndelag County of Norway revealed that patients who reported more than four somatic symptoms had an increased odds of having both anxiety and depression (OR 4.4; 95% CI). Chi-square analysis showed that women had a higher prevalence of somatic symptoms compared to men. The severity of somatic symptoms increased when the patient was diagnosed with both depression and anxiety ($p < 0.05$). The prevalence of four or more somatic symptoms in patients with both depression and anxiety linearly increased with age (Haug, Mykletun, & Dahl, 2004). This study revealed that age and gender are significant factors in the presentation of somatic symptoms in patients with anxiety or depression.

Investigators in Spain conducted a cross-sectional, multi-center study to assess how somatic symptoms presented in patients with anxiety (N = 422) to patients with both anxiety and depression (N = 559). ANOVA analyses showed that painful somatic symptoms were more

prevalent in patients with both anxiety and depression ($p < 0.001$) (Romera et al., 2010). This study showed that specific somatic symptoms present in patients with a dual diagnosis of anxiety and depression.

A cross-sectional study in Guangzhou, China examined somatic symptoms in 2,408 male and female clinical patients being treated for anxiety and depression in 15 general hospitals outpatient clinics from July to December 2007. The Hospital Anxiety and Depression Scale was used to assess the severity of depression and anxiety symptoms and the PHQ – 15 was used to assess somatic symptoms. Investigators used logistic regression to examine the prevalence of somatic symptoms and the relationship between the severity of symptoms and the mental health diagnosis. The prevalence of somatic symptoms was higher in female patients (75.1% of reported somatic symptoms) compared to males. Patients with increased reports of somatic symptoms were more likely to be diagnosed with depression and anxiety ($p < 0.001$). Younger patients were also more likely to have an increased severity in both mental health and somatic symptoms ($p < 0.01$) (Zhu et al., 2012). This study revealed that both gender and age are important factors in the relationship between somatic symptoms, anxiety, and depression.

As previously highlighted, culture impacts the presentation of somatic symptoms, anxiety, and depression (Dreher et al., 2017; Zhou et al., 2011). The studies discussed above provide further depth to the research about the relationship between somatic symptoms, anxiety, and depression. A significant limitation of these studies was the failure to control for all secondary variables associated with the study variables, such as culture, age, and gender. The findings may not be fully generalizable across all different communities and cultures, such as the active-duty military population.

Discussion and Application

The body of literature shows that somatic symptoms are significantly related to both anxiety and depression in adult patients. The varying analytical methodologies, such as Pearson correlation, linear regression, and multinomial logistic regression, are a strength of the presented studies (Aoki et al., 2012; Burton, Farley, & Rhea, 2009; Sugahara et al., 2004). These methods provided strong foundational evidence on the association between the variables of interest. While each of these analytical methods show the relationship between the variables, the methods differ in the type of association that they show. For example, the Pearson correlation provides a measurement of the linear relationship between the variables of interest (Burton, Farley, & Rhea (2009). Whereas the logistic regression provides information on the strength of the association (Sugahara et al., 2004). These methods revealed that there is a strong relationship between somatic symptoms, anxiety, and depression. The lack of research among active-duty military members was a major gap in the literature review. Further research is needed to understand how the relationship between somatic symptoms, anxiety, and depression presents in active-duty service members.

Another strength of the literature review was that studies all revealed the depth of the association between somatic symptoms, anxiety, and depression and the multiple factors that can impact the overall symptom presentation across varying populations. For example, fatigue, sleep issues, shoulder stiffness, and back pain are more prevalent in patients with anxiety (Sugahara et al., 2004; Zhao et al., 2018; Nomura et al., 2007). Whereas “feeling weak, or tired all over”, general feelings of malaise, and feelings of weakness were more prevalent among patients with depression (Grover et al., 2012; Vaccarino, Sills, Evans, & Kalali, 2008). The literature review also showed that the prevalence of somatic symptoms increases as the severity of anxiety and depression increase (Jat et al., 2022; Nakao, Yamanaka, & Kuboki, 2001; Zhu et al., 2012).

The literature review also revealed that females had a higher prevalence of somatic symptoms compared to males with the same diagnosis (Grover et al., 2012; Sugahara et al., 2004). The impact of age in the prevalence of somatic symptoms in patients with anxiety or depression varied across the studies. Age was positively associated with the relationship between somatic symptoms, anxiety, and depression in a cross-sectional, multi-center study in Spain (Haug, Mykletun, & Dahl, 2004). A Japanese study among adult outpatients did not find a difference in the prevalence of somatic symptoms across varying age groups (Sugahara et al., 2004). The variance in the findings could be caused by the small population size of these studies. Further research is needed to understand the impact of age on the study variables.

The presentation of somatic symptoms among patients with anxiety and depression is more prevalent in regions and cultures where mental health conditions have been stigmatized, such as Asian cultures (Hoge et al., 2006Wong & Fong, 2015; Zhou et al., 2011), There is limited literature of the relationship between these variables within the United States. This review of literature did not identify any studies conducted among the active-duty military population. Further research is needed to understand the role of the military culture on the presentation of somatic symptoms in patients with anxiety and depression.

The literature review highlighted important clinical practice implications. Somatic symptoms can be present before a medical provider diagnoses a patient with a mental health condition (Aoki et al., 2012; Burton, Farley, & Rhea, 2009). Untreated mental health symptoms can cause an increase in the presence of somatic symptoms and negatively impact the whole health of individuals. (Wong & Fong, 2015). Several novel studies examined the predictive relationship between somatic symptoms. These studies revealed that the presence of somatic symptoms increased the risk for a future diagnosis of both depression and anxiety. These results highlight the importance of understanding the relationship between the study variables, as

somatic symptoms could be considered as a risk factor when screening patients for possible anxiety or depression (Aoki et al., 2012; Nakao & Yano, 2006a; Nakao & Yano, 2006b; Nakao & Yano, 2003; Terre et al., 2003).

There are limitations associated with the findings in the presented studies. The methods used to conduct psychological assessments varied across all studies. Some studies used a variety of self-reported questionnaires, such as the PHQ – 15 or the Hamilton Depression Inventory (Burton, Farley, & Rhea, 2009; Vaccarino, Sills, Evans, & Kalali, 2008; Wong & Fong, 2015). One study gathered data from a large medical database without specifying the type of psychological assessment tools used to gather the data (Simon, VonKorff, Piccinelli, Fullerton, & Ormel, 1999). The severity scales vary within each of these tools, which may result in different interpretations of the severity of somatic, anxiety, and depressive symptoms reported by study participants.

An additional limitation was the great variance in the study population compositions. The smallest population size included 79 participants and the largest study population included 50,377 participants (Haug, Mykletun, & Dahl, 2004; Zhou et al., 2011). The results from studies with larger participation populations (N= 5447; N= 760) showed relationships between sociodemographic variables, such as gender and socioeconomic status, and somatic, anxiety, and depressive symptoms (Haug, Mykletun, & Dahl, 2004; Simon, VonKorff, Piccinelli, Fullerton, & Ormel, 1999; Sugahara et al., 2004). The small size of some studies impacted the accuracy of the findings (Arnault, Sakamoto, & Moriwaki, 2006; Hoge et al., 2006).

Conclusion

The body of literature provides foundational evidence that somatic symptoms are associated with anxiety and depression in adult patients and can be used to inform the diagnosis and treatment of anxiety and depression. The key limitations of these studies were the variance in

the methods used to conduct psychological assessments and the variance in the population size. Despite these limitations, the literature review revealed the depth of the association between somatic symptoms, anxiety, and depression as well as the impact of socioeconomic and demographic factors and culture on this relationship. A large gap in the literature is the limited evidence to show how the military culture may impact the prevalence of somatic symptoms in active-duty service members with anxiety or depression. Further research is needed to examine the relationship between the study variables, controlling for socioeconomic, and demographic factors. Such research will expand on the existing literature on this topic and guide military medical practices. Without this knowledge, anxiety, depression, and somatic symptoms will continue to negatively impact active-duty service members, military readiness, and the Military Health System.

CHAPTER 3: Methods

Several studies have documented the relationship between somatic symptoms, anxiety, and depression in adult patients (Simon, VonKorff, Piccinelli, Fullerton, & Ormel, 1999; Wong & Fong, 2015). Somatic symptoms are directly associated with increased mental health distress, such as anxiety and depression, and increased health care utilization in adult patients (Gierk et al., 2014). Some studies identified that somatic symptoms may be used as an indicator to predict a future mental health diagnosis (Aoki et al., 2012). The relationships between somatic symptoms, anxiety, and depression have not been well researched in the United States active-duty Service member population.

This chapter presents an overview of the research methods, to include the study design, population, measures, data collection procedures, and analysis methods. Next, the chapter will present how ethics and quality assurance issues will be addressed throughout the study. Finally, this chapter provide a timeline for the completion of the proposed research.

Study Design

An original secondary data analysis will be conducted on cross sectional data collected from 16,699 participants from the DoD funded 2015 HRBS. The HRBS is a cross-sectional survey used by the DoD to examine the health, health-related behaviors, and well-being of service members. In 2014, the Defense Health Agency contracted the RAND Corporation to administer the HRBS to non-deployed active and reserve component service members across military branches. The final report was published in 2018 (Meadows et al., 2018).

2015 HRBS Methodology

HRBS Measures/Instruments

RAND researchers modified the questions from previous versions of the HRBS to create a new survey for the 2015 study participants. The 2015 HRBS shortened the length of the survey by 25 percent and focused on questions related to service member finances, housing, substance use, and health related concerns. The 2015 HRBS contained psychological self-reporting scales, which measure somatic symptoms, anxiety, and depression within the survey. Somatic symptoms were measured using the SSS-8. This scale asks the individual to measure how much they were bothered by the following symptoms over the past seven days:

- Stomach or bowel problems
- Back pain
- Pain in the arms, legs, or joints
- Headaches
- Chest pain or shortness of breath
- Dizziness
- Feeling tired or having low energy
- Trouble sleeping

Individuals are able to respond using a five-point Likert Scale, where 0 equals “not at all” and 4 equals “very much”. The score of all eight questions is totaled, resulting in a possible score of 0 -32. The total scores are grouped into five categories to describe the burden the somatic symptoms have on the individual’s life:

- 0-3 points = no somatic symptom burden
- 4-7 points = low somatic symptom burden

- 8-11 points = medium somatic symptom burden
- 12-15 points = high somatic symptom burden
- 16-32 points = very high somatic symptom burden (Gierk et al., 2014; Meadows et al., 2018).

Anxiety symptoms were measured using the GAD - 7. This scale asks the individual to measure how much they were bothered by the following symptoms over the past two weeks:

- Feeling nervous, anxious, or on edge
- Not being able to stop or control worrying
- Worrying too much about different things
- Trouble relaxing
- Being so restless that it is hard to sit still
- Becoming easily annoyed or irritable
- Feeling afraid, as if something awful might happen (Meadows et al., 2018).

The GAD -7 differs from the SSS – 8. Individuals taking the GAD – 7 questionnaires are able to respond using a four-point Likert Scale, where 0 equals "not at all" and 4 equals "almost every day". The score of all seven questions is totaled, resulting in a possible score of 0 -21. The total scores are grouped into four categories to describe severity of the individual's anxiety:

- 0–4 points = minimal anxiety
- 5–9 points = mild anxiety
- 10–14 points = moderate anxiety
- 15–21 points = severe anxiety (Spitzer, Kroenke, Williams, & Löwe, 2006).

Depression symptoms were measured using the PHQ - 9. This scale asks the individual to measure how much they were bothered by the following symptoms over the past two weeks:

- Little interest or pleasure in doing things
- Feeling down, depressed, or hopeless
- Trouble falling or staying asleep, or sleeping too much
- Feeling tired or having little energy
- Poor appetite or overeating
- Feeling bad about yourself — or that you are a failure or have let yourself or your family down
- Trouble concentrating on things, such as reading the newspaper or watching television
- Moving or speaking so slowly that other people could have noticed? Or the opposite — being so fidgety or restless that you have been moving around a lot more than usual
- Thoughts that you would be better off dead or of hurting yourself in some way (Kroenke, Spitzer, and Williams, 2001; Meadows et al., 2018).

Similar to the GAD -7, the PHQ-9 uses a four-point Likert Scale, where 0 equals "not at all" and 4 equals "almost every day". The score of all seven questions is totaled, resulting in a possible score of 0 -27. The total scores are grouped into five categories to describe severity of the individual's depressive symptoms:

- 0–4 points = minimal depression
- 5–9 points = mild depression
- 10–14 points = moderate depression
- 15–19 points = moderately severe depression
- 20–27 points = severe depression (Kroenke, Spitzer, & Williams, 2001).

HRBS Data Collection Procedures

The 2015 HRBS was administered online. Researchers invited Service members to participate in the online survey through a standard mail letter. Researchers sent follow up invitations through email and post card delivery. The online survey was open from November 2015 to April 2016 (Meadows et al., 2018).

HRBS Study Population and Sampling

The 2015 HRBS used a non-proportional, stratified random sample of non-deployed Service members from the Army, Navy, Marine Corps, Air Force and Coast Guard were eligible to participate in the HRBS. The 2015 HRBS excluded National Guard and Reserve component Service members. Researchers used data provided by the Defense Manpower Data Center to identify the sample population. The final sample for 2015 HRBS was 16,699 surveys. This study will include all active-duty Service members from the 2015 HRBS. The study will exclude Coast Guard, National Guard, and Reserve Service members, as these individuals are not part of the active-duty military population (Meadows et al., 2018).

HRBS Institutional Review Board Processes

The 2015 HRBS research plans were reviewed by several Institutional Review Boards (IRB) to include: The RAND Corporation IRB, regional IRBs, the Office of People Analytics, the Office of the Under Secretary of Defense for Personnel and Readiness's Research Regulatory Oversight Office, the Office of the Assistant Secretary of Defense for Health Affairs and the Defense Health Agency's Human Research Protection Office, and the DoD Security Office (Meadows et al., 2018).

Data Analysis Methods

Raw data from the results of the 2015 survey will be used as provided by the Uniformed Services University of the Health Sciences (USUHS) HRBS principal investigator for HRBS related studies. Analysis of data will be conducted using the SAS version 9.4 programming language (Cary, North Carolina). Weighted prevalence and 95% confidence intervals will be provided to summarize the prevalence of somatic symptoms, anxiety, and depression within the survey population. A subgroup analysis of the weighted prevalence of somatic symptoms, anxiety, and depression will also be conducted within the study populations by social and demographic factors. Unadjusted and adjusted logistic regression models will be used to identify factors associated with high odds of somatic symptoms and mental health indicators in the survey population.

The study variables are SSS-8, GAD-7, and PHQ-9 scores. SSS – 8 scores are the independent variables and GAD- 7 and PHQ -9 scores are the dependent variables. The sum of the responses from the independent and dependent variables will be grouped into ordinal scales for analysis. The ordinal scales will be based on the screening grouping outlined in the psychological self-reporting scales discussed above. The SSS-8 scores will be grouped into a five point ordinal scale: 1) 0-3 points, 2) 4-7 points, 3) 8-11 points, 4) 12-15 points, 5) 16-32 points (Gierk et al., 2014). The GAD- 7 scores will be grouped into a four point ordinal scale: 1) 0–4 points, 2) 5–9 points, 3) 10–14 points, 4) 15–21 points (Spitzer, Kroenke, Williams, & Löwe, 2006). The PHQ -9 scores will be grouped into a five-point ordinal scale: 1) 0–4 points, 2) 5–9 points, 3) 10–14 points 4) 15–19 points 5) 20–27 points (Kroenke, Spitzer, & Williams, 2001).

Mental health indicators will also be grouped into one multinomial variable, to include probable GAD (yes/no) and probable depression (yes/no). A multinomial variable will be used to identify the presence of probable anxiety only, probable depression only, and presence of both

probable anxiety and probable depression. The category 'none' would be used as a reference category.

The 2015 HRBS report grouped demographic variables into ordinal and nominal scales for analysis and reporting (Meadows et al., 2018). The methodology of the original survey will be followed to group demographic variables into the following ordinal, categorical, and nominal scales:

- Branch of Service (ordinal scale): 1) Air Force, 2) Army, 3) Marine Corps, 4) Navy.
- Pay Grade (ordinal scale): 1) E1-E4, 2) E5-E6, 3) E6-E9, 4) W1-W5, 5) O1-O3, 6) O4-O10
- Gender (nominal scale): 1) male, 2) female.
- Ethnicity (ordinal scale): 1) Hispanic, 2) White, non-Hispanic, 3) Black, non-Hispanic, 4) Asian, non-Hispanic, 5) Two+ races, non-Hispanic, 6) Other, non-Hispanic
- Age (categorical scale): 1) 24 or younger, 2) 25-34 years old, 3) 35 – 44 years old, 4) 45 or older.

To answer the first specific aim, a weighted prevalence of somatic symptoms, anxiety, and depression will be completed by the screening severity level within the study population. A subgroup analysis of the weighted prevalence of anxiety and depression will be completed within the study populations by the following subgroups:

- Branch of Service
- Pay Grade
- Gender
- Ethnicity
- Age

To answer the second aim, an adjusted weighted ordinal logistic regression model and an adjusted weighted multinomial logistic regression model will be used to examine the significance of the relationships between somatic symptoms, anxiety, and depression in the 2015 HRBS survey population controlling for the covariates indicated below:

- Branch of Service
- Pay Grade
- Gender
- Ethnicity
- Age

Adjusted ORs and the confidence intervals will be used to report the strength of the association between the study variables. A *p* value of less than 0.05 is considered significant.

To answer the third aim, unadjusted weighted ordinal logistic regression models and unadjusted weighted multinomial logistic regression model will be used to examine the significance of the relationships between somatic symptoms, anxiety, and depression within the following subgroups:

- Branch of Service
- Pay Grade
- Gender
- Ethnicity
- Age

Unadjusted ORs and the confidence intervals will be used to report the strength of the association between the study variables, wherein a *p* value of less than 0.05 will be considered significant.

Ethics and Human Subjects Issues

This research proposal is part of the USUHS umbrella protocol DBS.2020.074 (Ref#939650), entitled "Exposures associated with health outcomes using DoD surveys of health related behaviors among active-duty personnel". This research involves the analysis of de-identified data not collected for the purposes of this study. The research protocol was reviewed by the USUHS's Human Research Protections Program Office and was determined to be considered research not involving human subjects as defined by 32 CFR 219.102. As a result, this research proposal will require the USUHS Human Research Protections Program approval for IRB-exempt status.

Environment and Quality Assurance

The USUHS HRBS principal investigator will share data electronically via secure, password protected university email. Data will be stored in a password protected file on each researchers' personal computer and in a firewall protected networked, USUHS Google Drive shared folder. The PI will use a password protected external hard drive to back up the data to reduce the risk of data loss. USUHS study grant funds will be used to purchase the SAS version 9.4 software package, external hard drive, and computer. The program will be downloaded for use on the researcher's computer. All data analysis will occur at the USUHS library or on the researcher's computer at her home office.

Study Period

The study will begin in September 2022 and end in May 2023. In September 2022, the researcher will submit the USUHS Student Research Proposal, University Form 3202 to the Dissertation Chair for approval. In September 2022, the researcher will submit the research proposal to the USUHS Human Research Protections Program office for approval for an IRB-

exempt notice. Upon approval of the research proposal, the researcher will begin analysis of the provided data in the Fall 2022 semester. The researcher will begin compiling the results in January 2023. The study will end and conclude with the Dissertation Defense with the presentation of the final findings in May 2023.

Conclusion

The expected primary outcome is to contribute to the assessment and diagnosis of anxiety and depression within active-duty service members by identifying a somatic symptom focused assessment process for identifying possible mental illness. The secondary outcome of this study is to increase scientific evidence to inform the clinical decision making process in the diagnosis of mental illness.

CHAPTER 4: Results

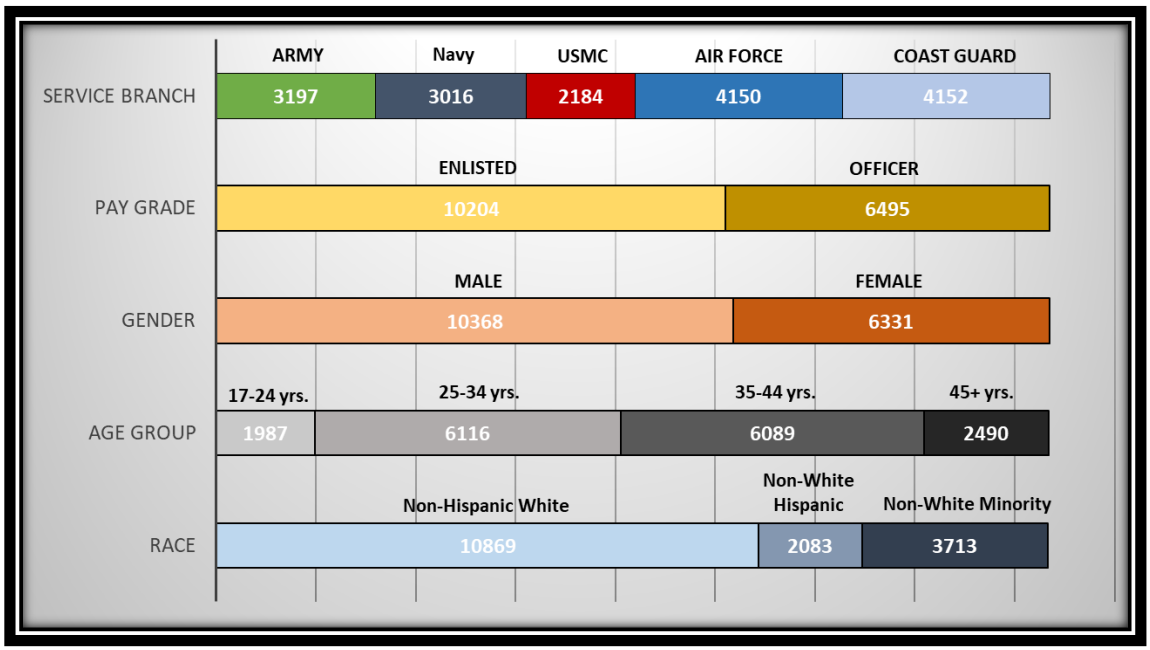
The purpose of this study is to examine the relationship between somatic symptoms, anxiety, and depression in the DoD active-duty military population. This chapter presents the findings of a secondary data analysis of 2015 HRBS survey responses using the SAS version 9.4 programming language (Appendix C) and highlights the prevalence of and relationship between somatic symptom, anxiety, and depression in the study population.

Prevalence of Anxiety, Depression, and Somatic Symptoms among Subjects Who Participated in the 2015 HRBS

The 2015 HRBS data included responses from 16,699 active-duty adult participants. We used SAS prevalence analyses and frequency functions to examine Specific Aim 1, and we used Wald's chi square to examine Specific Aims 2. The participant data was broken into subgroups based on branch of service, gender, rank, age group, and race. Branch of service was separated into five groups, Army (19.1%), Navy (18.1%), Marine Corps (13.1%), Air Force (25.0%), and Coast Guard (25.0%).

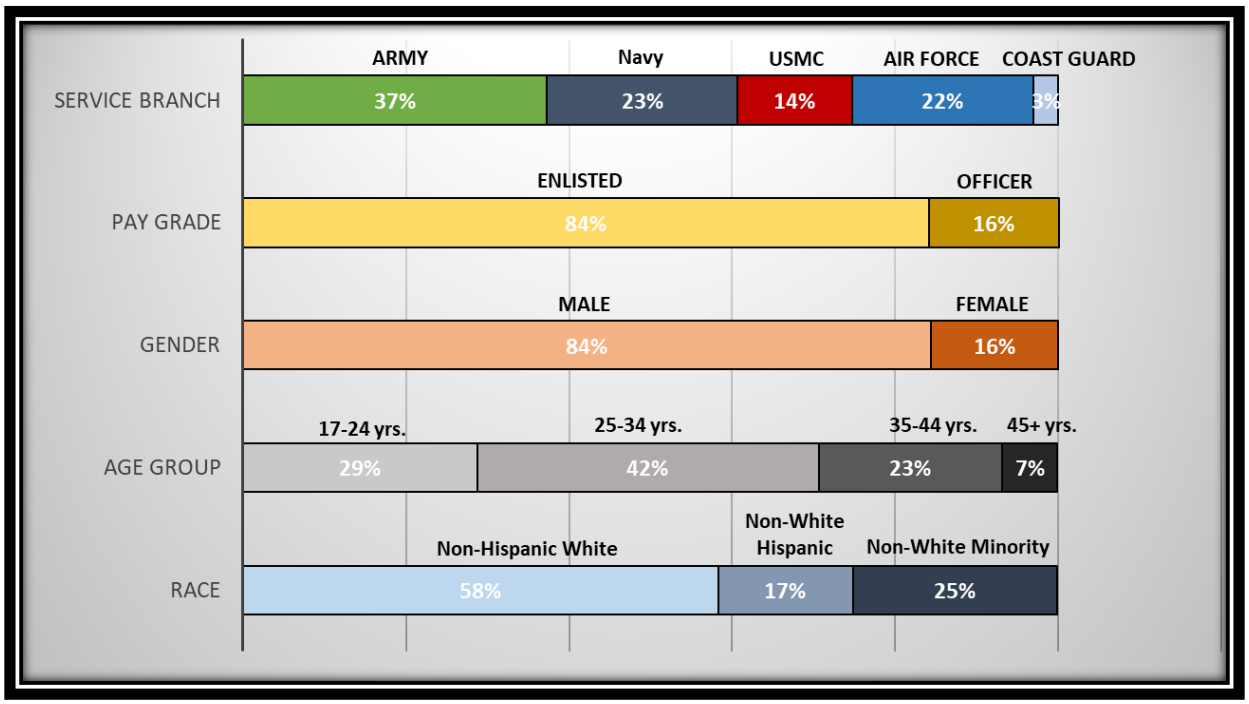
Respondents were not able to identify their rank in the survey; rather, respondents could identify whether they were an enlisted member or an officer, with the majority of survey participants identifying as enlisted. Participants' ages were separated into four groups, with the majority of participants between the ages of 25 to 34 or 35 to 44 years of age. Finally, participants were able to self-identify into one of three race groups, non-Hispanic white, non-white Hispanic, and non-white minority. The majority of participants self-identified as non-Hispanic white (Figure 5).

Figure 5: Prevalence of the 2015 HRBS Participant Population



The unweighted prevalence counts present the actual counts of participants within the varying subgroups. These counts do not accurately represent the 2015 military population (Figure 5). For this reason, the 2015 HRBS data included a post-stratification weight, which allows researchers to calculate the weighted prevalence of the population. The weighted prevalence increases the representation of Army, enlisted, and male participants. This model also balances the prevalence of the varying age groups and races presented in the study (Figure 6; Table 4). The weighted prevalence was used for all prevalence reporting throughout the remaining chapters.

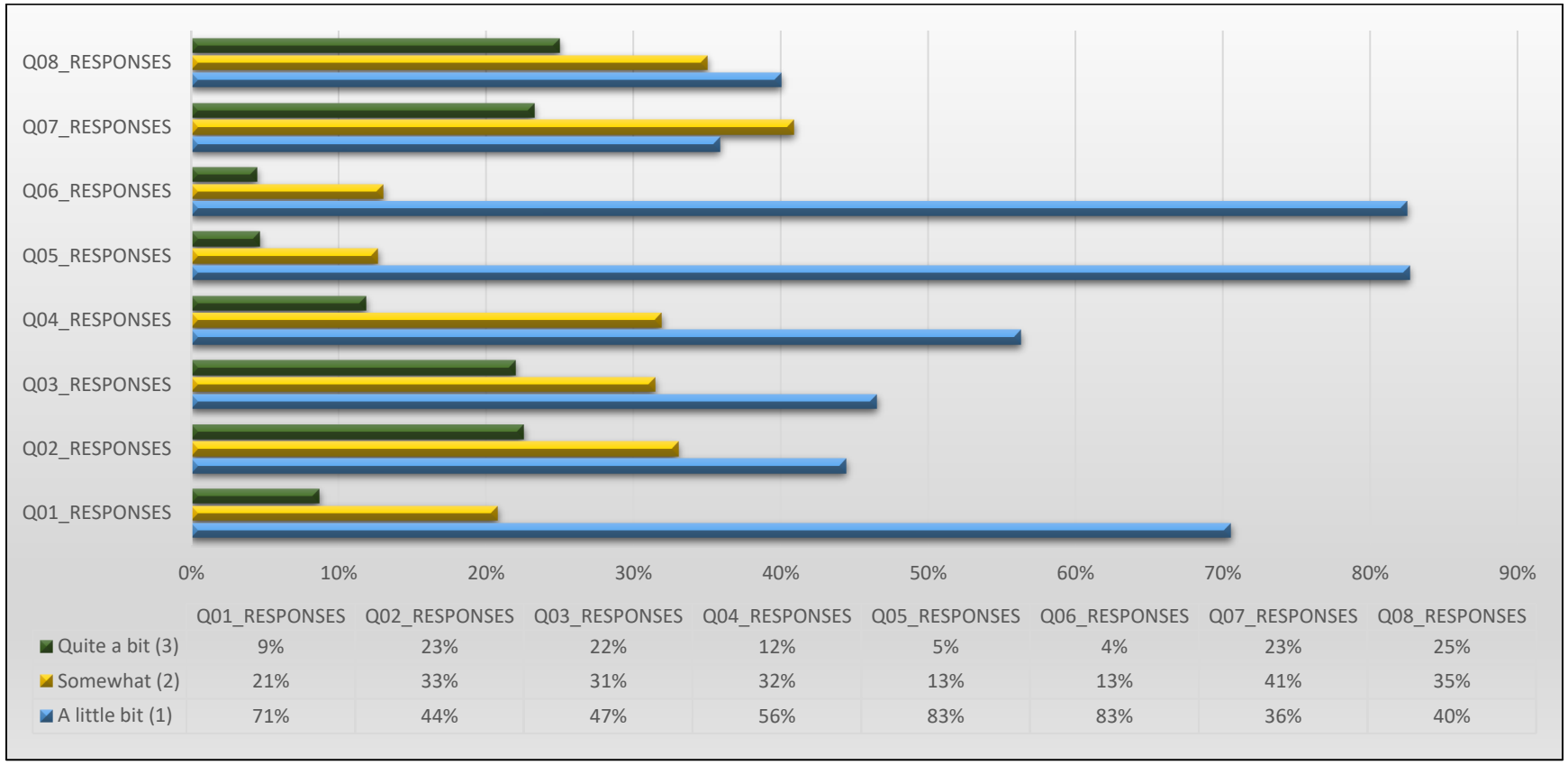
Figure 6: Weighted Prevalence of the 2015 HRBS Participant Population



Prevalence of Different Somatic Symptoms

The frequency function showed that across all somatic symptoms, the majority of participants reported being "a little bit" bothered by somatic symptoms over the past 30 days. Study participants were most frequently "a little bit bothered" by chest pain or shortness of breath (Q5; 82.7%), dizziness (Q6; 82.5%), and stomach or bowel problems (Q1; 70.5%). Study participants were most frequently "somewhat" bothered by feeling tired or having low energy (Q7; 40.9%), trouble sleeping (Q8; 40.0%), and back pain (Q2; 32.5%), Participants were most frequently "quite a bit" bothered by trouble sleeping (Q8; 25.0%) and pain in arms, legs, or joints (Q3; 22.0%) (Figure 7; Table 5).

Figure 7: Prevalence of Different Somatic Symptoms among Active-Duty Service Members Who Participated in the 2015 HRBS



	Q01_RESPONSES	Q02_RESPONSES	Q03_RESPONSES	Q04_RESPONSES	Q05_RESPONSES	Q06_RESPONSES	Q07_RESPONSES	Q08_RESPONSES
Quite a bit (3)	9%	23%	22%	12%	5%	4%	23%	25%
Somewhat (2)	21%	33%	31%	32%	13%	13%	41%	35%
A little bit (1)	71%	44%	47%	56%	83%	83%	36%	40%

Q01: *Stomach or bowel problems*	**Q02**: *Back pain*	**Q03**: *Pain in the arms, legs, or joints*	**Q04**: *Headaches*
Q05: *Chest pain or shortness of breath*	**Q06**: *Dizziness*	**Q07**: *Feeling tired or having low energy*	**Q08**: *Trouble sleeping*

Prevalence of Somatic Symptom Burden

The SSS-8 severity categories provide a self-reported measure to describe the burden somatic symptoms have on an individual's life (Gierk et al., 2014). The weighted prevalence revealed that approximately 99 percent of the current sample experienced medium to very high somatic burden (Table 4). The prevalence and severity of somatic symptoms varied across the HRBS subgroups. The majority of participants across all military branches, ranks, and races reported medium somatic burden. The majority of male participants reported medium somatic burden (47.5%), and the majority of female participants reported high somatic symptom burden (39.4%) (Table 6).

The majority of participants between 17 - 24 and 25 - 34 years of age reported medium somatic symptoms burden (51.9%; 48.3%). Wald's chi-square revealed that the relationship between somatic symptoms, branch of service, pay grade, gender, age, and race was significant ($p < .0001$; race $p < .0030$). These results support the hypothesis that the overall prevalence of somatic symptoms is significantly different based on branch of service, rank, gender, age, and race. The Wald's chi-square results support the hypothesis that individual demographic factors (branch of service, pay grade, gender, age, and race) are related to the diagnostic severity of somatic symptoms (Table 6).

Prevalence of Anxiety Symptoms

Across all subgroups the population prevalence of anxiety symptoms decreased as symptom severity increased. The overall prevalence of anxiety symptoms was similar across all age groups and races. The prevalence of anxiety symptoms varied by branch of service, pay grade, and gender. When examining branch of service, the majority of participants across all subgroups reported mild anxiety symptoms. The Marine Corps and

Navy populations had the highest population prevalence of moderate anxiety symptoms (26.3%; 25.8%) and severe anxiety symptoms (24.9%; 20.2%) (Table 7).

The prevalence of anxiety symptoms also varied by pay grade and gender. A greater percentage of the total enlisted population reported moderate to severe anxiety symptoms (24.4%; 19.6%) compared to the officer population (21.0%; 9.5%). A greater percentage of the total female population reported moderate to severe anxiety symptoms compared to the male population (23.1%; 17.2%) (Table 7).

There was a statistically significant relationship between the relationship between anxiety symptom severity, branch of service, pay grade, and gender (p <.0001). The Wald's chi-square analysis revealed that the relationship between anxiety symptoms, age, and race was not statistically significant (p =.6411; p =.5082) (Table 7). These findings suggest that only certain demographic variables (branch of service, pay grade, and gender) may impact the severity of anxiety in active-duty servicemembers.

Prevalence of Depression Symptoms

Moderate depression symptoms were most prevalent across all subgroups. Similar to the prevalence of anxiety, the prevalence of depression symptoms varied by branch of service, pay grade, and gender, but remained similar across all age groups and races. The Marine Corps had the highest population prevalence of moderately severe and severe depression symptoms (18.5%; 20.0%) (Table 8). The weighted prevalence of depression symptoms was similar to the weighted prevalence of anxiety symptoms in the population pay grades. A greater percentage of the total enlisted population reported moderately severe to severe depression symptoms (16.6%; 18.1%) compared to the officer population (13.4%; 7.3%) (Table 8).

The prevalence of mild depression symptoms was greater in males compared to females (30.2%; 22.5%). The weighted prevalence of moderate depression was similar amongst both genders (male = 38.4%; female = 39.0%). A greater percentage of the total female population reported moderately severe and severe depression symptoms compared to the male population (male = 15.6%, 15.8%; female = 18.8%, 19.7%) (Table 8).

The relationship between branch of service, pay grade, gender, and depression symptom severity was statistically significant (p <.0001). The Wald's chi-square analysis revealed that the relationship between age, race, and depression symptoms was not statistically significant (p <.3706; p <.9211). (Table 8). These findings are similar to the anxiety analysis, suggesting that only certain demographic variables (branch of service, pay grade, and gender) may also impact the severity of depression in active-duty servicemembers.

Prevalence of Mental Health Indicators

The 2015 HRBS defined "probable anxiety" as a GAD-7 score of 10 or greater and "probable depression" as a PHQ-9 score of 15 or greater (Meadows et al., 2018). This definition was used to generate a Mental Health Indicator variable for this study. The Mental Health Indicator variable identified if participants reported probable anxiety, probable depression, or a combination of both. The frequency function revealed that across all subgroups, the majority of participants did not meet the criteria for probable anxiety or probable depression. Across all subgroups, there was little variance in the weighted population prevalence of probable depression. Less than five percent of the subgroup populations met the criteria for probable depression. There was a higher

weighted prevalence of probable anxiety in Navy and Army (15.8%; 15.6%) participants compared to the Army, Air Force, and Coast Guard (11.7%; 11.5%; 14.2%) (Table 9).

The prevalence of both probable anxiety and depression varied by branch of service, pay grade, and gender. The Marine Corp had a greater population prevalence of probable anxiety symptoms in (35.6%). Enlisted participants represented the highest population prevalence of both probable anxiety and depression (30.7%) compared to the officer participant population (17.8%). The female participants reported the highest population prevalence of both probable anxiety and depression (34.5%) compared to the male participant population (27.5%). The population prevalence of both probable anxiety and depression was similar across age groups and races.

The relationship between branch of service, pay grade, gender, and both probable anxiety and depression was significant (p <.0001). The Wald's chi-square analysis revealed that the relationship between age, race and both probable anxiety and depression was not significant (p <.7402; p <.1436) (Table 9). These findings suggest that only certain demographic variables (branch of service, pay grade, and gender) may impact prevalence of probable anxiety, probable depression, or comorbid anxiety in active-duty servicemembers.

Relationship between Somatic Symptoms and Anxiety and Depression

The weighted prevalence and severity of somatic symptoms varied in participants with co-occurring somatic and anxiety symptoms. The weighted prevalence and severity of somatic symptoms also varied in participants with co-occurring somatic and depression symptoms. The majority of participants with medium somatic burden reported mild to moderate depression symptoms (50.1%; 39.2%). While the majority of

participants with high somatic burden reported moderate depression symptoms (45.1%). Those with very high somatic burden reported severe depression symptoms (52.4%) (Table 10).

There is a relationship between somatic symptom burden and anxiety and depression symptom severity. The results of the Wald's chi-square analysis revealed that there was a statistically significant relationship between co-occurring somatic and anxiety symptoms and co-occurring somatic and depression symptoms ($p < .0001$) (Table 10). These findings suggest that somatic symptom severity is significantly associated with the severity of anxiety and depression within active-duty servicemembers.

Multinomial Logistic Regression Analysis of the Relationship between, Anxiety, Depression, and Somatic Symptoms

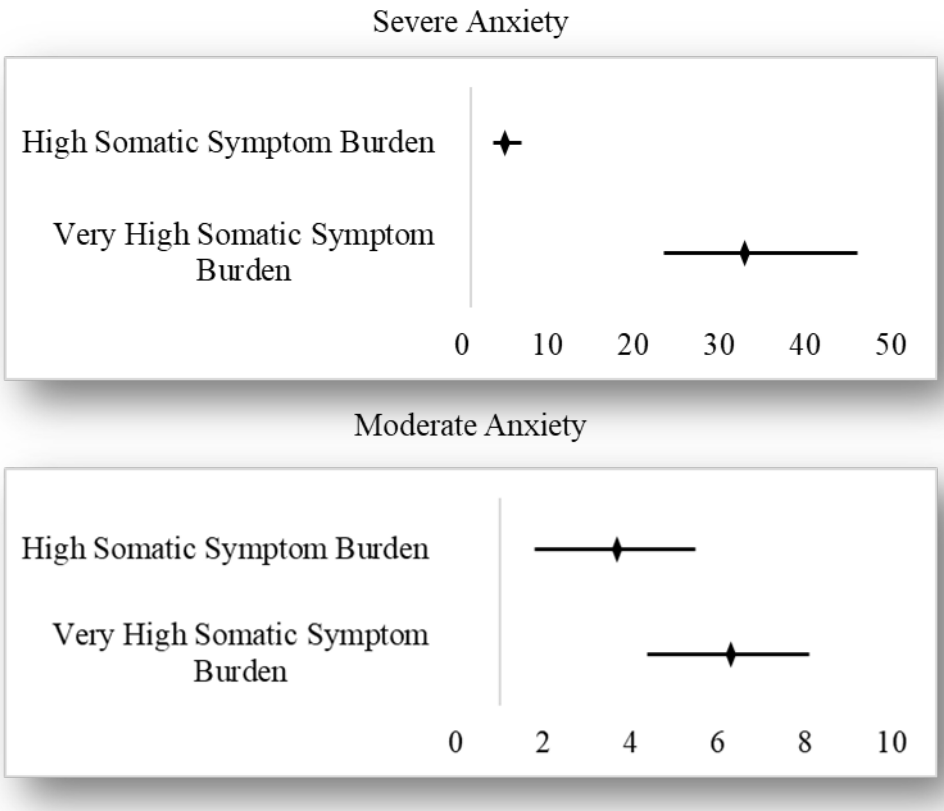
The unadjusted nominal MLR model assumes that there is no order to the categories of the independent data. Whereas the ordinal MLR model assumes that there is an order to the categories of the independent data and provides the odd ratios (OR) of independent variables to the cumulative somatic symptom severity score. We used unadjusted and adjusted multinomial logistic regression (MLR) models to determine if an increase in somatic symptom severity scores is associated with an increase in anxiety and depression scores within active-duty service members who participated in the 2015 HRBS (Specific Aim 3). As previously highlighted in Chapter 4, section titled "Prevalence of Somatic Symptom Burden", approximately 99 percent of all study participants reported medium to very high somatic burden. For this reason, we used moderate somatic symptom burden as the reference category for all nominal MLR

analyses. The reference groups for anxiety, depression, and Mental Health Indicators were “mild anxiety”, “mild depression”, and “none”, respectively.

Unadjusted Nominal MLR of Anxiety Symptom Severity

The unadjusted nominal MLR model of somatic symptoms and anxiety severity revealed that the OR of very high to high somatic symptom burden increased as anxiety symptom severity increased ($p < .0001$) (Table 11). Participants with very high somatic symptom burden were 33 times more likely to have severe anxiety symptoms and 6.3 times more likely to have moderate anxiety symptoms compared to participants with medium somatic symptom burden. Participants with high somatic symptoms burden were 5 times more likely to have severe anxiety symptoms and 3.7 times more likely to have moderate anxiety symptoms compared to participants with medium somatic symptom burden (Figure 8) (Table 11).

Figure 8: Forest Plot of the Nominal Unadjusted Odds Ratio of Anxiety and Somatic Symptom Severity

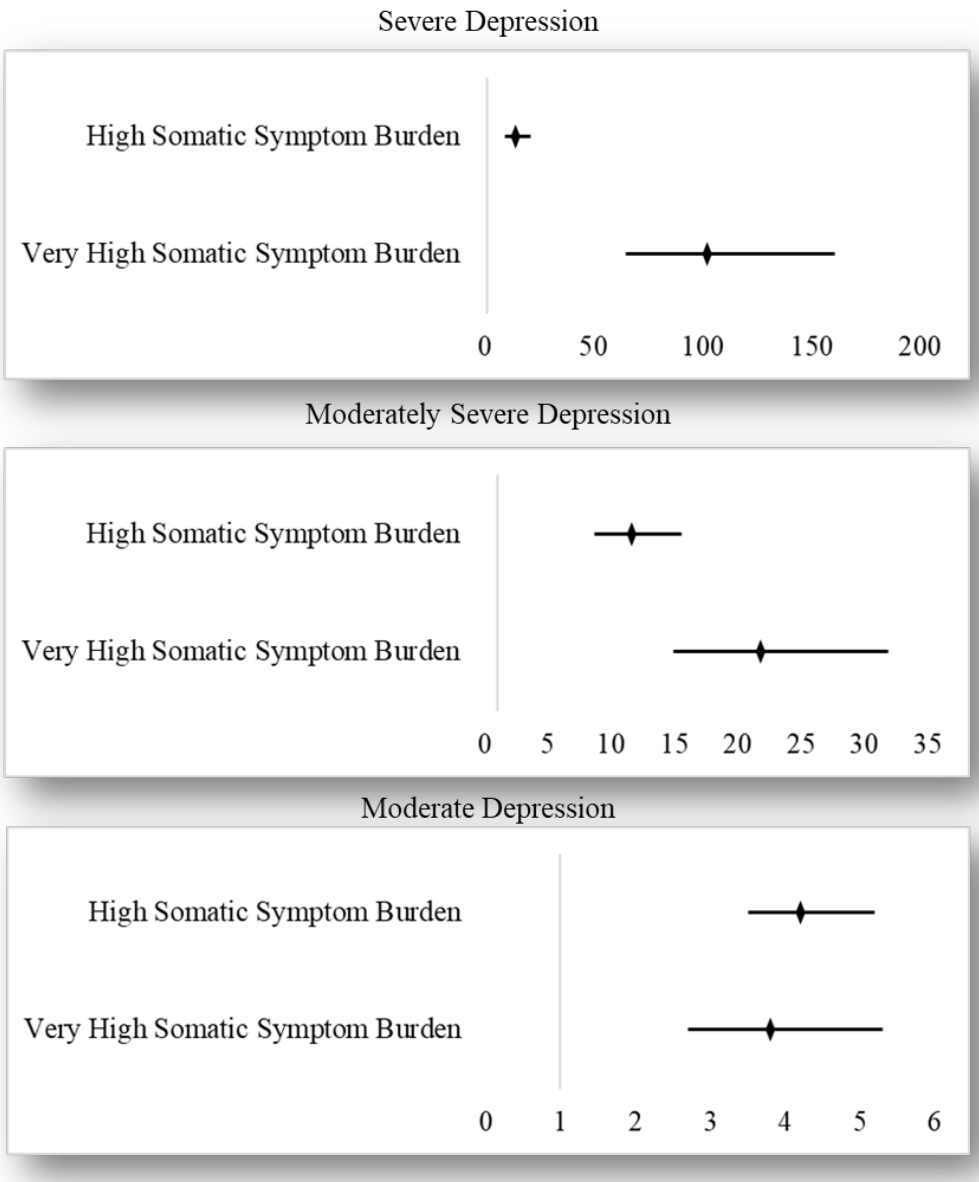


Unadjusted Nominal MLR of Depression Symptom Severity

The unadjusted nominal MLR model of depression symptom severity revealed similar findings to the analysis of anxiety symptoms. The OR of high to very high somatic symptom burden increased as depression severity increased ($p < .0001$) (Table 11). Participants with very high somatic symptom burden were 102.2 times more likely to have severe depression symptoms, 21.8 times more likely to have moderately severe depression symptoms, and 3.8 times more likely to have moderate depression symptoms compared to participants with medium somatic symptom burden. Participants with high somatic symptoms burden were 14 times more likely to have severe depression

symptoms, 11.6 times more likely to have moderately severe depression symptoms, and 4.2 times more likely to have moderate depression symptoms compared to participants with medium somatic symptom burden. (Figure 9) (Table 11).

Figure 9: Forest Plot of the Nominal Unadjusted Odds Ratio of Depression and Somatic Symptom Burden



Unadjusted Ordinal MLR of Anxiety and Depression Symptoms

While the nominal unadjusted MLR model provides a more detailed look at the relationship between the anxiety and depression severity levels and each somatic symptom severity level, the wide range of the lower and upper confidence intervals suggest that the population within each severity group may be too small to provide an accurate OR (Table 11). For this reason, both the anxiety and depression models were rerun using ordinal unadjusted MLR.

The unadjusted ordinal MLR model revealed that as somatic symptom burden increased, anxiety or depression symptom severity also increased ($p < .0001$) (Table 12 and Table 13). Participants with very high somatic symptom burden were 15.9 times more likely to have greater anxiety severity compared to participants with medium somatic symptom burden (Table 12). Participants with high somatic symptom burden were 23.9 times more likely to have greater depression symptom severity compared to participants with medium somatic symptom burden (Table 13).

Unadjusted Ordinal MLR of Demographic Variables

We found that certain demographic factors (branch of service, rank, and gender) were associated with an increased risk for greater anxiety and depression symptoms ($p < .0001$) (Table 12 and Table 13). We ran unadjusted ordinal MLR models for all demographic variables (branch of service, pay grade, gender, age, and race). The reference categories for the individual demographic factors were 'Army', 'Enlisted', 'Male', '17-24 yrs.', and 'Non-Hispanic White'. The results revealed Participants in the Marine Corps, Air Force, and Coast Guard were more likely to have greater anxiety symptom severity compared to participants in the Army (OR= 1.3; 0.5; and 0.6). Officers

were 0.5 times more likely to have greater anxiety symptom severity compared to participants in the compared to enlisted participants. Female participants were 1.4 times more likely to have greater anxiety symptom severity compared to male participants. The relationship between age, race, and depression symptom severity was not significant (p=.9722; p=.7047) (Table 12).

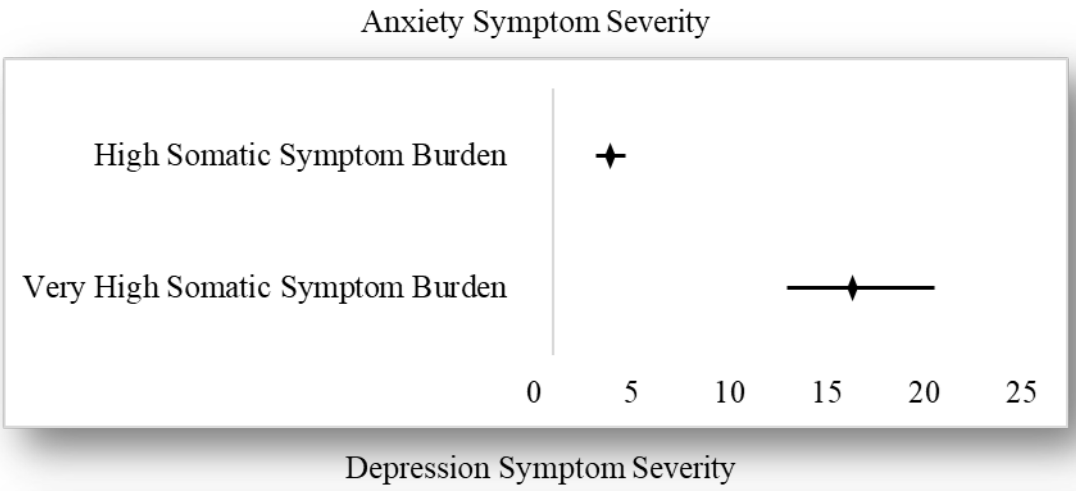
Participants in the Marine Corps, Air Force, and Coast Guard were more likely to have greater depression symptom severity compared to participants in the Army (OR= 1.1; 0.5; and 0.6). Officers were 0.6 times more likely to have greater depression symptom severity compared to participants in the compared to enlisted participants. Female participants were 1.4 times more likely to have greater anxiety symptom severity compared to male participants. The relationship between age, race, and depression symptom severity was not significant (p=.9722; p=.7047) (Table 13).

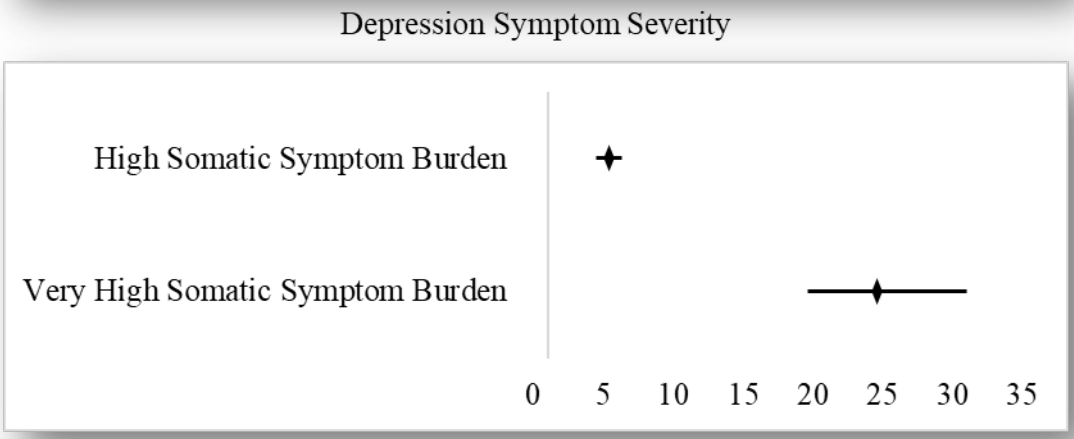
Adjusted Relationship between Somatic Symptom Burden and Anxiety and Depression

We ran adjusted ordinal MLR models for somatic symptom burden and anxiety and depression symptom severity, controlling for all demographic variables, as the Wald's chi-square analysis revealed that all demographic variables (branch of service, rank, gender, age, race) had a relationship with somatic symptom severity ($p < .0001$; race: p=.0030) (Table 6). Additionally, we found that there was overlap between the questions in the SSS-8 and PHQ-9 questionnaires. Both questionnaires asked participants about "trouble sleeping". We determined that controlling for this question in both the SSS-8 and PHQ-9 results would result in an equivalent change in the cumulative score of each questionnaire. For this reason, we did not adjust for the overlapping question.

The adjusted ordinal MLR results were very similar to the unadjusted models. Participants with very high somatic symptom burden were 16.3 times more likely to have greater anxiety severity compared to participants with medium somatic symptom burden ($p < .0001$) (Table 12). Participants with high somatic symptom burden were 24.6 times more likely to have greater depression symptom severity compared to participants with medium somatic symptom burden ($p < .0001$) (Table 13).

Figure 10: Forest Plot of the Ordinal Adjusted Odds Ratio of Anxiety, Depression, and Somatic Symptom Burden

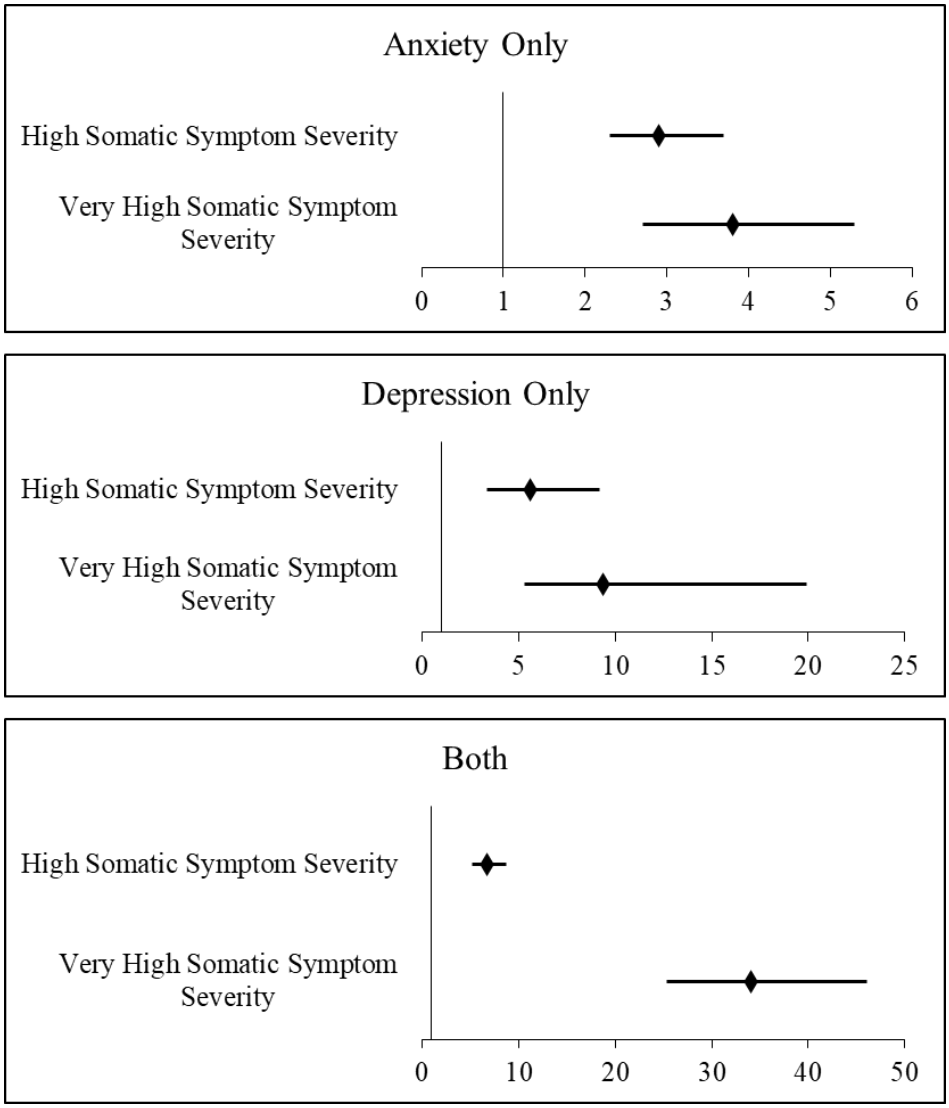




Somatic Symptoms and Mental Health Indicators

We found that somatic symptom burden was related to the co-occurring anxiety and depression. We ran an adjusted nominal MLR of the Mental Health Indicator variable to determine if somatic symptom severity is related to the presence of probable anxiety, probable depression, or both. Within this model the Mental Health Indicator variable was the independent variable and somatic symptom burden was the independent variable. The findings of this analysis reinforced the previous results. Participants with high somatic symptom burden were 2.9 times more likely to have probable anxiety, 5.6 times more likely to have probable depression, and 6.8 times more likely to have both diagnoses compared to participants with medium somatic symptom burden. The OR increased as the somatic symptom severity increased. Participants with very high somatic symptom burden were 3.8 times more likely to have probable anxiety, 9.4 times more likely to have probable depression, and 34.1 times more likely to have both diagnoses compared to participants with medium somatic symptom burden ($p < .0001$) (Table 15) (Figure 11). These results reveal that somatic symptom severity may worsen in the presence of both anxiety and depression. These results also suggest that there is a bi-directional relationship between mental health symptom severity and somatic symptom severity, as somatic symptom severity levels could provide a measure of association to mental health diagnoses.

Figure 11: Forest Plot of the Unadjusted Odds Ratio of Somatic Symptom Burden and Mental Health Indicators



Adjusted Nominal MLR of Demographic Variables

We found that certain demographic factors were associated with an increased risk for probable anxiety, probable depression, or co-occurring anxiety and depression ($p < .0001$) (Table 15). The adjusted nominal MLR of the Mental Health Indicator variable revealed that participants in the Navy and Marine Corps were more likely to have probable anxiety compared to participants in the Army (OR= 1.5; 1.6). Officers were 0.6

times more likely to have co-occurring anxiety and depression compared to enlisted participants. Female participants were 1.4 times more likely to have probable anxiety and 1.2 times more likely to have co-occurring anxiety and depression compared to male participants. Participants between the ages of 35-44 years and those over 45 years were more likely to have co-occurring anxiety and depression compared to participants between the ages of 17-24 years (OR= 0.7; and 0.6). Non-white minority participants were 0.7 times more likely to have probable anxiety and 0.7 times more likely to have co-occurring anxiety and depression compared to non-white Hispanic participants (Table 15).

Conclusion

The results of the prevalence function supported the hypothesis that the overall prevalence of symptoms varies based on branch of service, rank, gender, age, and race (Specific Aim 1). The Wald's chi-square revealed that individual demographic factors (branch of service, pay grade, gender, age, and race) are associated with somatic symptoms severity (Specific Aim 2). The results of the Wald's chi-square analysis to examine the relationship between co-occurring somatic symptoms and anxiety and co-occurring somatic symptoms and depression suggest that somatic symptom severity is significantly associated with the severity of anxiety and depression within active-duty servicemembers. All MLR models supported the hypothesis that individual demographic factors have a statistically significant relationship with the diagnostic severity of somatic symptoms, anxiety, and depression. The unadjusted and adjusted ordinal MLR models of anxiety and depression symptom severity revealed that the OR of high to very high somatic symptom burden increased as depression or anxiety severity increased ($p <$

.0001). The ORs revealed that the impact of demographic factors on anxiety and depression symptom severity risk was low compared to the impact of somatic symptoms on anxiety and depression symptom severity risk (Specific Aim 3). The results of the unadjusted and adjusted MLR models results supported the central hypothesis for this study, revealing that increases in somatic symptom burden are associated with a greater odds of increased anxiety and depression symptom severity.

Chapter 5: Discussion

The body of literature shows a growing prevalence of both somatic symptoms and mental health issues in adult patients, burdening health care systems (Gierk et al., 2014; Haller, Cramer, Lauche, & Dobos, 2015; Hanssen, Finch, & Rosmalen, 2021; Park & Gilmour, 2017). This burden is heightened due to the growing evidence supporting the relationship between somatic symptoms, anxiety, and depression in adult patients (Aoki et al., 2012; Burton, Farley, & Rhea, 2009; Sugahara et al., 2004; Simon, VonKorff, Piccinelli, Fullerton, & Ormel, 1999; Wong & Fong, 2015). Several foundational studies found that somatic symptoms severity can be used as an indicator for a future diagnosis of anxiety and depression (Aoki et al., 2012; Dijkstra-Kersten et al., 2015; Nakao & Yano, 2006a; Nakao & Yano, 2006b; Nakao & Yano, 2003; Terre et al., 2003).

Across the body of literature researchers examined the relationship between somatic symptoms, anxiety, and depression, controlling for demographic variables such as culture, age, gender, and socio-economic status, through calculating the results of patient self-report symptom questionnaires and analyzing these data to identify the degree of association between the study variables. These studies did not identify how somatic symptoms, anxiety, and depression present in the in the active-duty military population. This study followed the foundational methodology in the body of literature to explore prevalence of and relationship between somatic symptoms, anxiety, and depression in the military population. In addition, this study examined the relationship between demographic variables, to include branch of service, pay grade, gender, age, and race, and anxiety, depression, and somatic symptom severity within active-duty service members.

Prevalence of Somatic Symptoms, Anxiety, and Depression

Somatic symptoms, anxiety, and depression were measured by their diagnostic severity. The 2015 and 2018 HRBS reports examined the prevalence of each somatic symptom across the participant populations, and the 2015 HRBS report analyzed the prevalence of high somatic symptom burden among service members who had deployed in the last three years. Neither report explored somatic symptom severity levels across the population (Meadows et al., 2018; Meadows et al., 2021). Our weighted analysis of the entire 2015 HRBS population revealed over 99 percent of the population had medium to very high somatic symptom burden, with over 20 percent reporting very high somatic symptom burden (Table 4). These results suggest that the majority of the of the active duty military population may be experiencing somatic symptoms, increasing the risks on military readiness.

Previous studies found that specific somatic symptoms were associated with anxiety and depression (Burton, Farley, & Rhea, 2009; Nomura et al., 2007; Vaccarino, Sills, Evans, & Kalali, 2008; Zhao et al., 2018). Pain and trouble sleeping were associated with anxiety (Nomura et al., 2007; Burton, Farley, & Rhea, 2009). Feelings of "general malaise", such as stomach and bowel problems, and fatigue were associated with depression (Grover et al., 2012; Vaccarino, Sills, Evans, & Kalali, 2008). Our study found that study participants most frequently reported stomach or bowel problems (Figure 7; Table 5). These results suggest that the majority of the study population had symptoms that align with "general malaise.

Approximately 19 percent of adults in the United States are diagnosed with an anxiety disorder each year (National Alliance on Mental Illness, 2023). In January 2022,

27.9 percent of adults in the United States reported symptoms of anxiety (CDC, 2023). From 2016 to 2020 anxiety accounted for 16.7 percent of mental health diagnoses in the active duty military population (Armed Forces Health Surveillance Branch, 2021).We found that the results of the GAD -7 questionnaires are designed to the describe severity of the individual's anxiety, to include minimal anxiety, mild anxiety, moderate anxiety, and severe anxiety (Spitzer, Kroenke, Williams, & Löwe, 2006). The 2015 HRBS simplified the GAD-7 results into a binomial variable of "probable GAD", a score of 10 or higher, or none. This binomial variable did not provide a detailed look at anxiety symptom severity. Only 14 percent of the study's participants were categorized as having "probable GAD" (Meadows et al., 2018). This is less than the annual prevalence for anxiety in adults in the United States and in the active duty military population (National Alliance on Mental Illness, 2023; Armed Forces Health Surveillance Branch, 2021). Our analysis found that 89 percent of the population reported mild, moderate, or severe anxiety symptom severity, with 16 percent of the weighed population reporting severe anxiety symptoms (Table 4). This is significantly higher than the 2022 reported prevalence of anxiety symptoms in the U.S. general population (CDC, 2023).

Approximately eight percent of adults in the United States are diagnosed with depression each year (National Alliance on Mental Illness, 2023). In January 2022, 22.8 percent of adults in the United States had symptoms of depression (CDC, 2023). From 2016 to 2020 depression accounted for 16.5 percent of mental health diagnoses in the active duty military population (Armed Forces Health Surveillance Branch, 2021). The results of the PHQ-9 questionnaires are designed to describe severity of the individual's depressive symptoms, mild depression, moderate depression, moderately severe

depression, and severe depression (Kroenke, Spitzer, & Williams, 2001). The 2015 HRBS simplified the PHQ-9 results into a binomial variable of "probable depression", a threshold score of 15 or greater. Similar to the anxiety binomial variable, the depression binomial variable did not provide a detailed look at depression symptom severity. Only 9.4 percent of the study's participants were categorized as having "probable depression" (Meadows et al., 2018). This is higher than the annual prevalence of depression in adults in the United States and less than the prevalence in the active duty military population (National Alliance on Mental Illness, 2023; Armed Forces Health Surveillance Branch, 2021). Our weighted analysis found that 89 percent of the population reported mild, moderate, moderately severe, or severe depression symptom severity, with 14.4 percent of the population reporting moderately severe depression symptoms and 14.6 percent of the population reporting severe depression symptoms (Table 4). This is significantly higher than the 2022 reported prevalence of depression symptoms in the U.S. general population (CDC, 2023).

Increases in the prevalence and severity of anxiety symptoms can lead to an increase in the prevalence of somatic symptoms (Burton, Farley & Rhea, 2009; Nomura et al., 2007). Similarly, increases in the prevalence and severity of depression can be associated with increases in the prevalence and severity of somatic symptoms (Jat et al., 2022; Nakao, Yamanaka, & Kuboki, 2001; Taycan, Ozdemir, Erdogan-Taycan, & Jurcik, 2015). The high prevalence of both anxiety and depression symptoms across the study population suggests that there is a risk for increased somatic symptom burden within the active duty military population.

Demographic Factors and Symptom Prevalence

The body of literature suggests that culture, socio-economic status, gender, and age all impact the presentation of somatic symptoms, anxiety, and depression (Grover et al., 2012; Haug, Mykletun, & Dahl, 2004; Hoge et al., 2006;Wong & Fong, 2015; Simon et al., 1999; Zhou et al., 2011). Cultures with a stigmatized view of mental health often present with greater somatic symptom severity (Hoge et al., 2006; Wong & Fong, 2015; Zhou et al., 2011). One study found that patients with a high socioeconomic status sought care earlier for mental health symptoms, resulting in lower somatic, anxiety, and depression symptoms over time (Simon et al., 1999). Several studies suggest that the prevalence of somatic and anxiety symptoms is higher in females compared to males (Grover et al., 2012; Haug, Mykletun, & Dahl, 2004; Sugahara et al., 2004; Zhu et al., 2012). The prevalence of somatic symptoms, anxiety, and depression can vary across age groups, with younger adults having a higher prevalence of severe mental health and somatic symptoms compared to older adults (Haug, Mykletun, & Dahl, 2004; Zhu et al., 2012).

This study revealed that the prevalence and severity of somatic, anxiety, and depression symptoms varied among the participants' demographic subgroups (Table 4). Wald's chi-square revealed that individual demographic factors (branch of service, pay grade, gender, age, and race) have a statistically significant relationship with the prevalence of anxiety, depression, and somatic symptoms severity levels (Table 6; Table 7; Table 8). The weighted prevalence and Wald's chi-square of the Mental Health Indicator variable suggests that the branch of service, rank and gender may influence the presentation of co-occurring anxiety and depression diagnoses (Table 9). Thus,

demographic variables should be included in future logistic regression analyses of anxiety, depression, and somatic symptoms.

Culture and Symptom Prevalence

Active-duty service members are part of two cultural groups, their ethnic culture and the culture of their branch of service. Both cultures impact how the service member perceives their symptoms and treatment options (Center for Deployment Psychology, 2019). This study examined culture through the variables “branch of service” and “race”. Our analysis found that the weighted prevalence of somatic symptoms, anxiety, and depression severity levels were similar across all reported race groups. We found that the weighted prevalence of somatic symptoms, anxiety, and depression severity levels varied across the branches of service. For example, the Air Force and Coast Guard populations had the highest prevalence of medium somatic burden, mild anxiety symptoms, and mild to moderate depression symptoms. Conversely, the Army and Marine Corps populations had the highest prevalence of very high somatic symptom burden and moderately severe to severe depression symptoms. The Marine Corps and Navy had the highest prevalence of moderate to severe anxiety symptoms (Table 6; Table 7; Table 8). The variance in the symptom prevalence suggests that there may be cultural factors within each branch of service that impacts the severity of somatic symptoms, anxiety, and depression within the active-duty population.

Socio-economic Status and Symptom Prevalence

The relationship between somatic, anxiety, and depression symptom prevalence and socioeconomic status is influenced by access to health care services. Individuals within a higher socioeconomic group are often more likely to seek early care and

treatment when symptoms present (Clark & Thompson, 1994; Simon et al., 1999). The military rank structure can be used as a proxy to measure socioeconomic status within the active-duty military population. The population is divided into two broad groups, enlisted and officer, where officers are considered to be in a higher socioeconomic status. The enlisted and officer population can be further divided into sub-groups based on pay grade. Regardless of rank, all active-duty service members have equal access to the care within the Military Health System (Clark & Thompson, 1994; Paz, Rouhanian, & Vogt, 2015). Nonetheless, our analysis found that enlisted participants had a higher weighted prevalence of somatic symptoms, anxiety, and depression severity levels compared to the officer population. Enlisted members had the highest weighted prevalence of very high somatic symptom burden, severe anxiety symptoms, and severe depression symptoms (Table 6; Table 7; Table 8). These results suggest that while the enlisted population has equal access to healthcare, there may be other contributing factors that impact the prevalence and severity of somatic, anxiety, and depression symptoms.

Gender and Symptom Prevalence

Our analysis found that across the participant population female participants had a higher weighted prevalence of somatic symptoms, anxiety, and depression severity levels compared male participants. Male participants had the highest weighted prevalence of medium somatic symptom burden, mild anxiety symptoms, and mild depression symptoms. Female participants had the highest weighted prevalence of somatic, anxiety, and depression symptoms across all severity levels (Table 6; Table 7; Table 8). These findings supported the body of literature, which suggest that females have a higher symptom severity for somatic symptoms, anxiety, and depression compared to males.

Age and Symptom Prevalence

Current literature on the relationship between age and somatic symptom prevalence has mixed results. Several studies found that younger populations had a higher prevalence of more severe somatic anxiety, and depression symptoms (Haug, Mykletun, & Dahl, 2004; Zhao et al., 2018; Zhu et al., 2012). Other studies did not find an association between the prevalence of somatic symptoms, anxiety, and depression across varying age groups (Hoge et al., 2006; Sugahara et al., 2004). This study revealed that participants between the ages of 17 – 24 years old predominantly reported medium somatic symptoms burden. Whereas participants over the age of 35 predominately reported high to very high somatic symptom burden. Participates between the age of 17 – 24 years old had a greater prevalence of severe anxiety and severe depression symptoms compared to other age groups (Table 6; Table 7; Table 8). These variance in these findings suggest that further research is needed to understand the impact of age on the study variables.

The Association between Somatic Symptom Burden and Anxiety and Depression Severity

Previous studies used varying analytical methods to examine the relationship between somatic symptoms and anxiety, revealing a direct association between somatic symptoms, stress, and anxiety (Burton, Farley, & Rhea, 2009; Nomura et al., 2007; Wong & Fong, 2015). The Spearman rank order correlation coefficient showed that the number of somatic symptoms was positively associated with the degree of stress ($p < 0.001$) (Nomura et al., 2007). Pearson correlation showed a positive correlation between the level of stress and somatic symptoms ($r = .87$, $p < .001$) (Burton, Farley, & Rhea, 2009).

Structural equation models also revealed a positive relationship between somatic symptoms, stress, and anxiety ($Z = 4.328$, $p < 0.001$), identifying that somatic symptoms increased as mental health symptoms increased (Wong & Fong, 2015).

The body of literature also suggests that there is a positive relationship between depression and somatic symptom burden (Jat et al., 2022; Taycan, Ozdemir, Erdogan-Taycan, & Jurcik, 2015; Nakao, Yamanaka, & Kuboki, 2001). Chi-square analysis revealed that the prevalence of somatic symptoms increased with the severity of depression ($p< 0.05$) (Jat et al., 2022). ANCOVA revealed that prevalence of somatic symptoms increased as the diagnostic severity of depression increased ($p < 0.001$) (Nakao, Yamanaka, & Kuboki, 2001). Multiple linear regression models revealed that the prevalence of somatic symptoms increases with the severity of depression when controlling for age, gender, and education ($p < 0.001$) (Taycan, Ozdemir, Erdogan-Taycan, & Jurcik, 2015).

Both the unadjusted nominal MLR and adjusted ordinal MLR models of somatic symptoms, anxiety, and depression presented in our study support the findings across the body of literature. The unadjusted nominal MLR model revealed increasing somatic symptom burden within participants reporting moderate or severe anxiety symptoms or moderate to severe depression symptoms ($p < .0001$) (Table 11, Table 12, and Table 13). There was a large increase in the odds ratio (OR) for high to very high somatic symptom burden for participants with severe anxiety symptoms compared to participants with mild anxiety symptoms and in participants with moderately severe to severe depression symptoms compared to participants with mild depression symptoms (Table 11). The adjusted ordinal MLR models' results were very similar to the unadjusted nominal and

ordinal models, suggesting that as somatic symptom burden increases, anxiety and depression symptom severity will also increase ($p < .0001$) (Table 14).

The Association between Mental Health Indicators and Somatic Symptom Burden

Somatic symptoms and depression have a bi-directional relationship. Somatic symptoms can present before or after a diagnosis of anxiety or depression (Aoki et al., 2012; Nakao & Yano, 2006a; Nakao & Yano, 2006b; Nakao & Yano, 2003; Terre et al., 2003). The adjusted ordinal MLR models of somatic symptoms, anxiety, and depression presented in our study suggest that the severity of anxiety or depression symptoms is linked to somatic symptom burden within active-duty service members. Similarly, the adjusted nominal MLR model of somatic symptom burden and Mental Health Indicators revealed that somatic symptom burden was linked to the presentation of probable anxiety or probable depression in our study population, further supporting the findings across the body of literature.

The presentation of somatic symptoms can vary when anxiety and depression are co-occurring (Haug, Mykletun, & Dahl, 2004; Romera et al., 2010; Zhu et al., 2012; Zhou et al., 2011). Researchers from three separate studies using logistic regression analysis found that adult patients with a high prevalence of somatic symptoms had an increased odds of having co-occurring anxiety and depression ($p < 0.05$; $p < 0.001$; $p < 0.001$) (Haug, Mykletun, & Dahl, 2004; Zhou et al., 2011; Zhu et al., 2012). ANOVA analyses also revealed an increase in reports of somatic symptoms in patients with both anxiety and depression ($p < 0.001$) (Romera et al., 2010).

In this study, somatic symptom burden was related to co-occurring anxiety and depression. Somatic symptom burden worsens in the presence of both anxiety and

depression, further supporting the findings across the body of literature. This model also revealed that participants with very high somatic symptom burden had an increased likelihood of having "probable anxiety" or "probable depression" compared to participants with medium somatic symptom burden (OR = 3.9, 9.4) ($p < .0001$). Furthermore, participants with very high somatic symptom burden had an even higher likelihood of having both "probable anxiety" and "probable depression" compared to participants with medium somatic symptom burden (OR = 25.3) ($p < .0001$) (Table 15).

The Association between Demographic Factors, Somatic Symptom Burden, and Anxiety and Depression Severity

The body of literature revealed significant associations between demographic factors and the relationship between somatic symptoms, anxiety, and depression. Studies have found that the severity of somatic symptoms in patients with anxiety may be associated with cultural and ethnic factors (Hoge et al., 2006; Wong & Fong, 2015; Zhou et al., 2011). One study an association between socioeconomic status and the presentation of somatic, anxiety, and depression symptoms over time (Simon et al., 1999). Results from studies in Japan and India revealed that there is an increased prevalence in the presentation of specific somatic symptoms across genders in patients with depression (Grover et al., 2012; Sugahara et al., 2004). Chi-square analysis supported these findings and found that both gender and age are significant factors in the presentation of somatic symptoms in patients with anxiety or depression ($p < 0.05$) (Haug, Mykletun, & Dahl, 2004). Chi-square tests showed that the prevalence of somatic symptoms varied across different age groups ($\alpha = 0.05/3 = 0.0167$). Fisher's z-test revealed a possible variation between the presentations of somatic symptoms across genders (Zhao et al., 2018).

Our study revealed that only culture (branch of service), socioeconomic status (pay grade), and gender were linked to somatic, anxiety, and depression symptom severity. The unadjusted ordinal odds ratio of anxiety, depression, demographic variables, and somatic symptoms revealed that the relationship between branch of service, pay grade, and gender and somatic, anxiety, and depression symptom severity was significant ($p<.0001$). The ORs for branch of service and pay grade were between 1.3 and 0.5, indicating that these factors were only mildly associated with an increased risk of outcome and symptom severity. The ORs for gender was moderately higher, with females being 1.4 times more likely to have a greater anxiety or depression symptom severity compared to males (Table 12 and Table 13).

The Association between Demographic Factors and Mental Health Indicators

There is a relationship between age, gender, and the relationship between somatic symptoms and co-occurring anxiety and depression. Chi-square analyses revealed that gender and age are associated with somatic symptom and co-occurring anxiety and depression severity ($p<0.05$) (Haug, Mykletun, & Dahl, 2004; Zhu et al., 2012). ANCOVA analyses also revealed a significant association between culture, somatic symptoms, and co-occurring anxiety and depression ($p=0.05$) (Zhou et al., 2011).

This study supports and expands on the findings from the body of literature. The adjusted nominal MLR of the Mental Health Indicator variable and somatic symptoms revealed a significant relationship between demographic variables, somatic symptoms and co-occurring anxiety and depression. Similar to the findings in the body of literature, culture (branch of service: $p<.0001$; and race: $p=.0123$), gender ($p<.0001$), and age ($p<.0001$) were significantly associated with co-occurring anxiety and depression. This

study also revealed that socioeconomic status (pay grade: $p<.0001$) was associated with co-occurring anxiety and depression. The ORs for the demographic variables and co-occurring anxiety and depression were between 1.2 and 0.4, indicating that these factors were only mildly associated with an increased risk of outcome and symptom severity (Table 15).

Limitations

There are several limitations to the presented findings. The results of the 2015 HRBS may not fully represent the military population due to the low response rate. The RAND Corporation invited 201,990 individuals to participate in the survey. However, the final report had a response rate of 8.6 percent, resulting in 16,699 usable surveys. In addition, the 2015 HRBS used self-reported health questionnaires to assess anxiety, depression, and somatic symptoms. There is a risk that the participant responses were minimized or overly exaggerated. Several studies have used structured clinical interviews to validate the accuracy of the self-reported anxiety and depression severity (DeArmond, Stallones, Chen, & Sinteck, 2006; Nakao, Yamanaka, & Kuboki, 2001; Nakao & Yano, 2006a; Ryder et al., 2008; Zhou et al., 2011). This study was a secondary data analysis, and we were not able to use this method to validate accuracy of participate response. For this reason, the self-reported anxiety, depression, and somatic symptom severity levels may not be entirely accurate.

Another limitation of this study is the inability to fully assess the varying military subgroups. This study used military rank to assess the socioeconomic status of study participants. The military pay grade structure is based on several factors, to include income, education, job type, and time in service. Analysis of the varying pay grades

provides a fuller understanding of the socioeconomic status of the military population (Paz, Rouhanian, Vogt, 2016). The 2015 HRBS response options did not represent the varying socioeconomic groups within the officer and enlisted population. While our analysis found that enlisted participants had a higher weighted prevalence of somatic symptoms, anxiety, and depression severity levels compared to the officer population, these findings may not be accurate across the entire enlisted population. The body of literature suggests that culture may impact the relationship between somatic symptoms, anxiety, and depression (Arnault, Sakamoto, & Moriwaki, 2006; Dreher et al., 2017; Hoge et al., 2006; Parker, Cheah, & Roy, 2001; Ryder et al., 2008; Simon et al., 1999; Wong & Fong, 2015; Zhou et al., 2011). The 2015 HRBS response options allowed participants to clearly identify the military branch, an element of military culture, but the survey response options were limited for ethnic cultures. The 2015 HRBS only included three ethnic response options and did not account for other ethnic groups, such as Asian or African-American. The results of this study may not fully represent the impact ethnic culture has on somatic symptoms, anxiety, and depression within the active-duty military population.

We were unable to control the population size of the subgroups within this secondary data analysis. The population size of participants reporting severe anxiety, severe depression, or both was relatively small. As seen in the results of the ordinal MLR models, the small population size impacted the accuracy of the results for the nominal model. The ordinal model does provide a more accurate OR; however, these findings may not entirely capture the relationship between the study variables.

Future Research

Further research is needed to inform mental health prevention, diagnosis, and treatment within the Military Health System. Research that examines the prevalence and relationship between somatic symptoms, anxiety, and depression within a variety of military sub-groups is needed to better inform tailored primary prevention strategies. Observation-based clinical research is needed to examine the relationship between clinically validated somatic symptoms, anxiety, and depression to learn if somatic symptom severity can be used as a supplementary diagnostic indicator for mental health distress.

Prospective, longitudinal studies in a larger sample of military members may be able to provide data on the predictive influence of somatic symptoms and symptom burden on the development of initial or worsening anxiety and depression. Large scale, population-based clinical research in diverse military populations will help to inform treatment options for individuals with anxiety and/or depression co-occurring with somatic symptoms.

Conclusion

In 2022, the White House stated that the United States is in the middle of a mental health crisis, with over 60 percent of adults reporting symptoms of anxiety or depression. The mental health crisis also impacts the active-duty military population. The 2018 HRBS Report found that 10 percent of active-duty service members reported experiencing serious mental health distress within the month prior to the survey administration (Meadows et al., 2021). In 2021, mental health disorders continued to be the leading cause of hospital admissions for active-duty service members (Armed Forces Health Surveillance Branch, 2022). For active duty service members the mental health

crisis is worsened by the shortage of military mental health providers, as there are not enough mental health providers to meet the demand (Holiday, Hepner, & Pincus, 2022).

Prevention and early detection of mental health disorders can reduce the prevalence of mental health conditions, improve patient outcomes and reduce the burden on health systems (Arango et al., 2018). The results of this study provide foundational information which can guide primary prevention interventions for subgroups within the military population that may have a greater likelihood for developing anxiety and depression. Additionally, the results of this study can be used to inform diagnosis and treatment of anxiety and depression. The findings of this study suggest that somatic symptoms may be an indicator of an underlying mental health disorder. Military medical providers should consider additional mental health assessments when an active-duty service member presents with multiple somatic symptoms or a high somatic symptom burden. Our findings suggest that as somatic symptoms decrease, anxiety and depression symptoms will also decrease. The bi-directional relationship, with symptoms presenting before or after a mental health diagnosis. between somatic symptoms, anxiety, and depression suggests that somatic symptoms can be used to assess improvement in the anxiety and depression symptoms of active-duty patients.

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Appendix A

Literature Review Search Terms

Total Results: 5,108 - 2,715 duplicates = 2,393 results

PubMed, 07/15/2022 – 1,507 results

("Adult"[mh] OR "Military Personnel"[mh] OR active-duty[tiab] OR adult*[tiab] OR air-force[tiab] OR army[tiab] OR college-student*[tiab] OR marines[tiab] OR military[tiab] OR navy[tiab] OR soldier*[tiab] OR service-member*[tiab] OR servicemember*[tiab] OR university-student*[tiab]) AND ("Medically Unexplained Symptoms"[Majr] OR somatic[ti] OR somatization[ti] OR medically-unexplained-symptom*[ti] OR (psychosomatic-symptom*[ti] AND somatic[tiab])) AND ("Anxiety"[majr] OR "Anxiety Disorders"[majr] OR "Depression"[majr] OR "Depressive Disorder"[majr] OR "Mental Health"[Majr] OR "Stress, Psychological"[majr] OR anxiety[tiab] OR stress*[tiab] OR depress*[tiab] OR mental-health[tiab]) AND english[lang] AND (1990:3000/12/12[pdat])

Embase, 07/15/2022 – 1,665 results

('adult'/de OR 'air force'/exp OR 'army'/exp OR 'college students'/exp OR 'navy'/exp OR 'young adult'/exp OR (active-duty OR adult* OR air-force OR army OR college-student* OR marines OR military OR navy OR soldier* OR service-member* OR servicemember* OR university-student*):ab,ti,kw) AND ('medically unexplained symptom'/exp/mj OR (somatic OR somatization OR medically-unexplained-symptom*):ti OR (psychosomatic-symptom*:ti AND somatic:ab,ti,kw)) AND ('anxiety'/exp/mj OR 'anxiety disorder'/exp/mj OR 'depression'/exp/mj OR 'mental health'/exp/mj OR 'mental stress'/exp/mj OR (anxiety OR stress* OR depress* OR mental-health):ab,ti,kw) AND [english]/lim AND [1990-2022]/py AND ([article]/lim OR [article in press]/lim OR [review]/lim OR [preprint]/lim)

CINAHL, 07/15/2022 – 710 results

(MH "Adult+" OR MH "Military Personnel+" OR MH "Students, College" OR active-duty OR adult* OR air-force OR army OR college-student* OR marines OR military OR navy OR soldier* OR service-member* OR servicemember* OR university-student*) AND (MM "Medically Unexplained Symptoms" OR TI (somatic OR somatization OR medically-unexplained-symptom*) OR (TI (psychosomatic-symptom*) AND somatic))) AND (MM "Anxiety+" OR MM "Anxiety Disorders+" OR MM "Depression+" OR MM "Mental Health" OR MM "Stress, Psychological+" OR anxiety OR stress* OR depress* OR mental-health)

Limiters - Publication Year: 1990-; Peer Reviewed; English

PsycINFO, 07/15/2022 – 1,226 results

(DE "Military Personnel" OR DE "Air Force Personnel" OR DE "Army Personnel" OR DE "Coast Guard Personnel" OR DE "Marine Personnel" OR DE "Navy Personnel" OR DE "College Students" OR active-duty OR adult* OR air-force OR army OR college-student* OR marines OR military OR navy OR soldier* OR service-member* OR servicemember* OR university-student*) AND (MM "Somatization" OR TI (somatic OR somatization OR medically-unexplained-symptom*) OR (TI (psychosomatic-symptom*) AND somatic))) AND (MM "Anxiety" OR MM "Anxiety Disorder" OR MM "Depression (Emotion)" OR MM "Mental Health" OR MM "Stress" OR anxiety OR stress* OR depress* OR mental-health)

Limiters - Publication Year: 1990-; Peer Reviewed; English

Appendix B

Table 3: Evidence Table

Topic/Research Question: *Association between Somatic Symptoms, Anxiety, and Depression*			**See key work search in Appendix A**	
Reference Citation: Author, Journal, Date	**Database/Search Tool Keywords Used**	**Purpose of Study**	**Research Questions/ Hypotheses**	**Study Design (RCT, Qualitative, Quantitative, Mixed)**
Aoki et al. (2012). Internal medicine (Tokyo, Japan)	See key work search in Appendix A	To examine the relationships between somatic symptoms and depressive conditions.	Do somatic symptoms predict the future diagnosis of depression?	Quantitative
Theory/ Framework	**Study Sample and Setting**	**Methods & Procedures Instruments /Means of Collecting Data**	**Study Analyses**	**Results & Findings**
None Identified	284 patients between the ages of 18 and 46 years at a Japanese university hospital general medicine clinic	Data were collected from psychological assessment tests, to include Zung Self Rating Depression Scale and a Somatic Symptom checklist	Multinomial logistic regression to assess the relationship between specific symptoms and the presentation of depression	Patients with between 2-4 somatic symptoms, with the top symptoms being general fatigue, headache, and sleeping problems later developed depression. Logistic regression showed that these symptoms had a significant relationship to the presentation of depression.
Reference Citation: Author, Journal, Date	**Database/Search Tool Keywords Used**	**Purpose of Study**	**Research Questions/ Hypotheses**	**Study Design (RCT, Qualitative, Quantitative, Mixed)**
Arnault, Sakamoto, & Moriwaki (2006). Transcultural Psychiatry	See key work search in Appendix A	To examine if there are differences in the presentation of somatic symptoms and depression in Japanese and American college students.	Does the presentation of somatic symptoms and depression vary by culture?	Quantitative
Theory/ Framework	**Study Sample and Setting**	**Methods & Procedures Instruments /Means of Collecting Data**	**Study Analyses**	**Results & Findings**
Culture as a macro-level phenomena	A convenience sample of 44 four female college students from a large Midwestern University and 50 female college students from a Tokyo Women's University	Beck Depression Inventory (BDI) and Pennebaker Inventory of Limbic Languidness (PILL) for somatic-distress items	Independent t-tests for comparisons, and regression analysis for correlations.	This analysis revealed that 31% of the variance of the Japanese depression scores could be explained by the somatic distress scores, while only about 1% of the variance of the American BDI was explained by those scores.

Reference Citation: Author, Journal, Date	Database/Search Tool Keywords Used	Purpose of Study	Research Questions/ Hypotheses	Study Design (RCT, Qualitative, Quantitative, Mixed)
Burton, Farley, & Rhea (2009). Journal of American Academy of Nurse Practitioners	See key work search in Appendix A	To examine the relationship between stress and somatic symptoms in military spouses.	Are stress and somatic symptoms related?	Quantitative
Theory/ Framework	**Study Sample and Setting**	**Methods & Procedures Instruments /Means of Collecting Data**	**Study Analyses**	**Results & Findings**
Stress and Coping	68 spouses of nondeployed servicemen and 62 spouses of servicemen deployed to a combat zone.	Survey through the use of the Perceived Stress Scale-10 and Patient Heath Questionnaire-15	Independent t-test; Pearson correlation was used to determine the relationship between perceived stress score and level of somatization in the total sample.	Spouses of deployed servicemen had significantly higher perceived stress scores than spouses of non-deployed service members. Somatization scores were also significantly higher in spouses of deployed versus nondeployed servicemen.
Reference Citation: Author, Journal, Date	**Database/Search Tool Keywords Used**	**Purpose of Study**	**Research Questions/ Hypotheses**	**Study Design (RCT, Qualitative, Quantitative, Mixed)**
DeArmond, Stallones, Chen, & Sinteck (2006). Journal of Agricultural Safety and Health	See key work search in Appendix A	To examine somatization as a risk factor for the onset of depressive disorders in a farm community	Do somatic symptoms predict the future diagnosis of depression?	Quantitative
Theory/ Framework	**Study Sample and Setting**	**Methods & Procedures Instruments /Means of Collecting Data**	**Study Analyses**	**Results & Findings**
None Identified	709 farm operators and their spouses from northeastern Colorado	Structured interview using the Center for Epidemiological Studies Depression Scale and the WHO neurological symptom inventory (Somatic symptoms)	Exploratory and confirmatory factor analyses were conducted on the symptom inventory	Two-factor structure: psychological & physical symptoms. While both of the factors were significantly correlated with depression, the factor with psychological items was more strongly related to depression.
Reference Citation: Author, Journal, Date	**Database/Search Tool Keywords Used**	**Purpose of Study**	**Research Questions/ Hypotheses**	**Study Design (RCT, Qualitative, Quantitative, Mixed)**
Dijkstra-Kersten. et al. (2015). Journal of Psychosomatic Research	See key work search in Appendix A	To examine somatization as a risk factor for the onset of depressive and anxiety disorders	Do somatic symptoms predict the future diagnosis of depression?	Quantitative
Theory/ Framework	**Study Sample and Setting**	**Methods & Procedures Instruments /Means of**	**Study Analyses**	**Results & Findings**

		Collecting Data		
None Identified	All data were from 2004–2007, 2981 participants aged 18 through 65 years were included in the study. Participants were recruited in different settings: the community (n = 564), primary care (n = 1610), and mental health services (n = 807)	Data gathered from the broader 4- year prospective data from the Netherlands Study of Depression and Anxiety (NESDA)	Associations between somatization and the occurrence of a subsequent depressive or anxiety disorder were quantified with Hazard Ratios (HRs). Cox regression analyses were to account for differences in time-at-risk	Somatization was a risk factor for the incidence of depression [Hazard Ratio per unit increase (HR); 95% Confidence Interval (CI): 1.13; 1.09–1.17] and anxiety [HR; 95% CI: 1.14; 1.09–1.18]; People with somatic symptoms have an increased risk for a future diagnosis of depression or anxiety.
Reference Citation: Author, Journal, Date	**Database/Search Tool Keywords Used**	**Purpose of Study**	**Research Questions/ Hypotheses**	**Study Design (RCT, Qualitative, Quantitative, Mixed)**
Dreher et al. (2017). Journal of Psychosomatic Research	See key work search in Appendix A	To compare Vietnamese and German patients regarding cultural dynamics of symptom presentation upon first admission to a psychiatric outpatient service	Does the presentation of somatic symptoms and depression vary by culture?	Quantitative
Theory/ Framework	**Study Sample and Setting**	**Methods & Procedures Instruments /Means of Collecting Data**	**Study Analyses**	**Results & Findings**
None Identified	110 Vietnamese and 109 German patients seeking psychiatric treatment at two outpatient clinics in Germany	Patient Health Questionnaire (PHQ-15 and 9 to assess depression and somatic symptoms)	Cronbach's alpha	Vietnamese patients showed higher somatic symptoms severity. This increased with Vietnamese patients with poor German language skills, who showed a significantly higher focus on somatic symptoms
Reference Citation: Author, Journal, Date	**Database/Search Tool Keywords Used**	**Purpose of Study**	**Research Questions/ Hypotheses**	**Study Design (RCT, Qualitative, Quantitative, Mixed)**
Grover et al. (2012). East Asian Archives of Psychiatry	See key work search in Appendix A	To study the prevalence and type of functional somatic complaints in patients with first episode depression.	Do the total prevalence of somatic symptoms increase with	Quantitative

			depression severity?	
Theory/ Framework	**Study Sample and Setting**	**Methods & Procedures Instruments /Means of Collecting Data**	**Study Analyses**	**Results & Findings**
None Identified	64 consecutive patients attending the walk-in clinic of psychiatry outpatient department at a multispecialty teaching hospital in North India. All study patients were recruited with their written informed consent and were seen during the period of 1 March to 30 June 2010	The 17-item Hamilton Depression Rating Scale (HDRS)27 was used to assess the severity of depression; The Patient Health Questionnaire–15 (PHQ-15)28,29 was used to assess somatic symptoms	Comparisons done through the Chi-square and Mann-Whitney tests. Correlations were examined through the Spearman rank correlation analysis	96% (n = 158) reported at least 3 somatic symptoms and over 75% (n = 128) had 6 to 15 somatic symptoms; back pain and pain in the arms, legs, or joints were significantly more prevalent in females; The total depression score had a significant positive correlation with the total number of somatic symptoms
Reference Citation: Author, Journal, Date	**Database/Search Tool Keywords Used**	**Purpose of Study**	**Research Questions/ Hypotheses**	**Study Design (RCT, Qualitative, Quantitative, Mixed)**
Han et al. (2014). Neuro-Endocrinology Letters	See key work search in Appendix A	To examine the influence of somatic symptoms on major depressive disorder severity	Does an increase in somatic symptoms result in increased depressive symptoms?	Quantitative
Theory/ Framework	**Study Sample and Setting**	**Methods & Procedures Instruments /Means of Collecting Data**	**Study Analyses**	**Results & Findings**
None Identified	207 Subjects were enrolled at the outpatient clinic of Psychiatry, Bucheon St. Mary's Hospital, Korea;	Korean versions of the Patient Health Questionnaire-9 (PHQ-9) for the severity of MDD (Han et al.p2008; Kroenke et al. 2001), the PHQ-15 for the severity of somatization and Generalized Anxiety Disorder Scale for anxiety	ANOVA was applied for comparisons; Chi-square/ Fisher's exact tests were used for comparisons of the proportion of severity of depression	Severity of somatic symptoms increased with depression severity; Results showed that there is a significant impact of somatic symptoms on the symptomatology as well as treatment outcomes in Korean female patients with MDD, indicating that clinicians should carefully evaluate somatic symptoms in patients with MDD in routine clinical practice
Reference Citation: Author, Journal, Date	**Database/Search Tool Keywords Used**	**Purpose of Study**	**Research Questions/ Hypotheses**	**Study Design (RCT, Qualitative, Quantitative, Mixed)**

Haug, Mykletun, & Dahl (2004). Psychosomatic Medicine	See key work search in Appendix A	To examine the connection between anxiety, depression, and functional somatic symptoms in a large community sample	Do somatic symptom impact the presentation of depression and anxiety?	Quantitative
Theory/ Framework	**Study Sample and Setting**	**Methods & Procedures Instruments /Means of Collecting Data**	**Study Analyses**	**Results & Findings**
None Identified	50,377 inhabitants aged 20 years and above in Nord-Trøndelag County of Norway	August 1995 to April 1997, HUNT-II sent personal invitations to take part in the study, which included a physical examination and a mental health assessment using the Hospital Anxiety and Depression Scale (HADS-A) and the depression subscale of the Hospital Anxiety and Depression Scale (HADS-D)	Chi-square tests were used to examine demographic differences in prevalence of study variables; Binary logistic regression was used to calculate the prevalence odds ratios	There was a strong association between anxiety, depression, and functional somatic symptoms, which was equally strong in men and women. The association between number of somatic symptoms and the total score on Hospital Anxiety and Depression Scale was linear, meaning as somatic symptoms increased, depressive symptoms also increased. This showed a statistically significant relationship between anxiety, depression, and somatic symptoms
Reference Citation: Author, Journal, Date	**Database/Search Tool Keywords Used**	**Purpose of Study**	**Research Questions/ Hypotheses**	**Study Design (RCT, Qualitative, Quantitative, Mixed)**
Hoge et al. (2006). The Journal of Nervous and Mental Disease	See key work search in Appendix A	To examine if culture and ethnicity influence somatic symptoms in patients with GAD	Nepali individuals with GAD would have a greater somatic focus when asked about symptoms than American participants with GAD.	Quantitative
Theory/ Framework	**Study Sample and Setting**	**Methods & Procedures Instruments /Means of Collecting Data**	**Study Analyses**	**Results & Findings**

Not Identified	Thirty subjects (33% female) from the psychiatry clinic at the Tribhuvan University Teaching Hospital in Kathmandu, Nepal, and 23 (39% female) from the Center for Anxiety And Traumatic Stress Disorders Research Program at the Massachusetts General Hospital in Boston, Massachusetts	Beck Anxiety Inventory (BAI)	Two-sided t tests to analyze group differences; Linear regression analyses were used to adjust for age and gender	Nepali patients with GAD had higher rates of somatic complaints than the American patients with GAD.
Reference Citation: Author, Journal, Date	**Database/Search Tool Keywords Used**	**Purpose of Study**	**Research Questions/ Hypotheses**	**Study Design (RCT, Qualitative, Quantitative, Mixed)**
Jat et al. (2022). PMJH	See key work search in Appendix A	To determine the association of somatic symptoms with depressive disorder	Does the outcome of depressive symptoms increase as somatic symptoms increase?	Quantitative
Theory/ Framework	**Study Sample and Setting**	**Methods & Procedures Instruments /Means of Collecting Data**	**Study Analyses**	**Results & Findings**
None Identified	140 clients 131 (93.60%) were females with age range of 22 to 44 years at clinic in Pakistan from 10 August 2019 to 31 January 2020	Department of Medicine at Hospital In Pakistan	chi-square tests were used to examine associations	Somatic symptoms were strongly associated with depressive disorder having p value less than 0.05.
Reference Citation: Author, Journal, Date	**Database/Search Tool Keywords Used**	**Purpose of Study**	**Research Questions/ Hypotheses**	**Study Design (RCT, Qualitative, Quantitative, Mixed)**
Nakao, Yamanaka, & Kuboki (2001). Psychopathology	See key work search in Appendix A	To examine the prevalence of somatic symptoms and psychiatric characteristics of major depression.	Is there a relationship between the level of depression and somatic	Quantitative

			symptoms?	
Theory/ Framework	**Study Sample and Setting**	**Methods & Procedures Instruments /Means of Collecting Data**	**Study Analyses**	**Results & Findings**
None Identified	2215 patients between 1994 and 1998 at a Japanese psychosomatic outpatient clinic.	DSM diagnosis and physician interviews to assess somatic symptoms	Chi-square test and ANCOVA	The total number of somatic symptoms was greater in the major depressive group than in the reference group (table 1). The prevalence of fatigue, insomnia, nausea/vomiting, and back pain was higher in the major depressive group than in the reference group
Reference Citation: Author, Journal, Date	**Database/Search Tool Keywords Used**	**Purpose of Study**	**Research Questions/ Hypotheses**	**Study Design (RCT, Qualitative, Quantitative, Mixed)**
Nakao & Yano (2006a). Journal of Affective Disorders	See key work search in Appendix A	To examine if somatic symptoms found in annual health examinations, could be predictive of major depression in the ensuing year	Are somatic symptoms predictive of depression?	Quantitative
Theory/ Framework	**Study Sample and Setting**	**Methods & Procedures Instruments /Means of Collecting Data**	**Study Analyses**	**Results & Findings**
None Identified	1027 non-major-depressive workers (706 men, mean age 35) attending annual health examinations at a research institute.	DSM diagnosis and physician interviews to assess somatic symptoms	Multinomial logistic regression to assess the relationship between specific symptoms and the presentation of depression	The prevalence of major depression in the ensuing year was 2.5%. (fatigue, lower back pain, dizziness, and nausea). lower back pain and dizziness at baseline were independent risk factors of major depression in the ensuing year
Reference Citation: Author, Journal, Date	**Database/Search Tool Keywords Used**	**Purpose of Study**	**Research Questions/ Hypotheses**	**Study Design (RCT, Qualitative, Quantitative, Mixed)**
Nakao & Yano (2006b). Psychiatry and Clinical Neurosciences,	See key work search in Appendix A	To examine relationship between somatic symptoms and depression	Do somatic symptoms predict the development of	Quantitative

			Depression?	
Theory/ Framework	**Study Sample and Setting**	**Methods & Procedures Instruments /Means of Collecting Data**	**Study Analyses**	**Results & Findings**
None Identified	1066 Japanese workers (732 men, mean age 35 years) attending annual health examinations at an institute in two successive years.	Hamilton Depression Scale (HDS- 17)/self-administered questionnaire including items of 12 major somatic symptoms	ANCOVA and Multinomial Logistic Regression	Somatic symptoms in year one led to a depression diagnosis of MDD for 5.9 percent of patients in the following year. Also symptoms increased in the following year. Three somatic symptoms (low back pain, dizziness, and abdominal pain) at baseline were significant risk factors of major depression for the following year. Dizziness at baseline significantly predicted major and minor depression for the following-lowing year as well. Somatic symptoms may be good predictors to screen for depression at health examination.
Reference Citation: Author, Journal, Date	**Database/Search Tool Keywords Used**	**Purpose of Study**	**Research Questions/ Hypotheses**	**Study Design (RCT, Qualitative, Quantitative, Mixed)**
Nomura, Nakao, Sato, Ishikawa, & Yano (2007). Journal of Occupational Health	See key work search in Appendix A	To assess the associations between job stress and somatic symptoms and to investigate the effect of individual coping on these associations.	Is there a relationship between stress and somatic symptoms?	Quantitative
Theory/ Framework	**Study Sample and Setting**	**Methods & Procedures Instruments /Means of Collecting Data**	**Study Analyses**	**Results & Findings**
None Identified	185 Japanese male office workers (21–66 yr. old) at a Japanese company in July 2006	Self-administered questionnaire- about job stress and physical assessment in the annual physical	Generalized linear regression	Somatic symptoms increased as job stress increased. The primary somatic symptom were general fatigue (66%), followed by shoulder stiffness (63%) and sleep disturbance (53%).
Reference Citation: Author, Journal, Date	**Database/Search Tool Keywords Used**	**Purpose of Study**	**Research Questions/ Hypotheses**	**Study Design (RCT, Qualitative, Quantitative, Mixed)**

Romera et al. (2010). Journal of Affective Disorders	See key work search in Appendix A	To assess the prevalence of PPS in patients with GAD vs patients with GAD and co-morbid major depressive disorder (MDD) and a control group (patients neither with GAD nor MDD)	Do somatic symptoms increase in patients with GAD alone?	Quantitative
Theory/ Framework	**Study Sample and Setting**	**Methods & Procedures Instruments /Means of Collecting Data**	**Study Analyses**	**Results & Findings**
None Identified	Primary Care Clinics in Spain; 372 control; 559 GAD and MDD; 422 GAD Only from April - June 2007	GAD screening - Hospital Anxiety and Depression Scale-Anxiety Subscale; Visual Analog Scale for somatic symptoms	Chi Square and multiple linear regression	The prevalence of painful somatic symptoms was twice as high in patients with GAD only compared to those without a diagnosis. The severity increase when the patient was also diagnosed with MDD.
Reference Citation: Author, Journal, Date	**Database/Search Tool Keywords Used**	**Purpose of Study**	**Research Questions/ Hypotheses**	**Study Design (RCT, Qualitative, Quantitative, Mixed)**
Ryder et al. (2008). Journal of Abnormal Psychology	See key work search in Appendix A	To examine the difference in somatic symptom presentation related to depression in Chinese and Euro-Canadian patients	(a) Do the Chinese indeed emphasize the somatic symptoms of depression relative to North Americans? (b) Under what assessment conditions is this Chinese somatic symptom emphasis observed? (c) Why does this Chinese somatic symptom emphasis take place?	Mixed Methods
Theory/ Framework	**Study Sample and Setting**	**Methods & Procedures Instruments /Means of Collecting Data**	**Study Analyses**	**Results & Findings**
Not Identified	Chinese (n = 175) and Euro- Canadian (n = 107) outpatients	Spontaneous problem report, structured clinical interview, and symptom questionnaire methods	Principle factor Analysis	Chinese outpatients reported somatic symptoms of depression compared with the Euro-Canadian patients. Euro-Canadians reported more of the psychological

				symptoms of depression.
Reference Citation: Author, Journal, Date	**Database/Search Tool Keywords Used**	**Purpose of Study**	**Research Questions/ Hypotheses**	**Study Design (RCT, Qualitative, Quantitative, Mixed)**
Simon et al. (1999). The New England Journal of Medicine	See key work search in Appendix A	To examine influence of culture on the relationship between somatic symptoms and depression	Do the Chinese Somatized Depression?	Quantitative
Theory/ Framework	**Study Sample and Setting**	**Methods & Procedures Instruments /Means of Collecting Data**	**Study Analyses**	**Results & Findings**
None Identified	Two sets of depressed outpatients, 50 Malaysian Chinese and 50 Australian Caucasians, matched by age and sex.	Internally developed questionnaire; DSM diagnosis by physician	Chi Square and multiple linear regression	The Chinese were distinctly more likely to nominate a somatic symptom as their presenting complaint (60% vs 13%), while the Australian subjects were more likely to nominate depressed mood, cognitive and anxiety items.
Reference Citation: Author, Journal, Date	**Database/Search Tool Keywords Used**	**Purpose of Study**	**Research Questions/ Hypotheses**	**Study Design (RCT, Qualitative, Quantitative, Mixed)**
Simon, VonKorff, Piccinelli, Fullerton, & Ormel (1999). The New England Journal of Medicine	See key work search in Appendix A	To examine the relationship between somatic symptoms and depression.	Are there variations in the probability of somaticized depression based on the country of origin and type of medical facility?	quantitative
Theory/ Framework	**Study Sample and Setting**	**Methods & Procedures Instruments /Means of Collecting Data**	**Study Analyses**	**Results & Findings**
None identified	5447 of the patients between the ages of 18 and 64 years were assessed in 1991 and 1992 at 15 primary care centers in 14 countries on 5 continents.	Data from the World Health Organization (WHO) presenting structured assessment of depressive and somatoform disorders using international assessment scales	Linear regression for comparisons of continuous measures and logistic regression for comparisons of categorical measures	The presentation of somatic symptoms in patients with depression varied greatly by country and region. Patients who sought care a primary care facility with a regular relationship with their provider were less likely to report somatic symptoms then patients at urgent care centers.
Reference Citation: Author, Journal, Date	**Database/Search Tool Keywords Used**	**Purpose of Study**	**Research Questions/ Hypotheses**	**Study Design (RCT, Qualitative, Quantitative, Mixed)**

Sugahara et al. (2004). Psychiatry Research	See key work search in Appendix A	To examine the major somatic and psychiatric symptoms associated with depression in each sex.	Does the presentation of depression and somatic symptoms vary by gender?	quantitative
Theory/ Framework	**Study Sample and Setting**	**Methods & Procedures Instruments /Means of Collecting Data**	**Study Analyses**	**Results & Findings**
None Identified	Patients diagnosed with a depressive disorder (n=335) and patients without depression (n=425) at a Japanese an urban hospital medical setting.	Data were collected from psychological assessment tests, to include the KMI and the Zung Self- Rating Depression Scale and a Somatic Symptom checklist	Logistic regression analysis was used to examine the association of specific symptoms to the patient gender,	Somatic symptom type varied by gender. Males were more likely to have diarrhea, excessive sweating and weight loss. Females were more likely to report headache, and general body pain.
Reference Citation: Author, Journal, Date	**Database/Search Tool Keywords Used**	**Purpose of Study**	**Research Questions/ Hypotheses**	**Study Design (RCT, Qualitative, Quantitative, Mixed)**
Taycan, Ozdemir, Erdogan-Taycan, & Jurcik (2015). Nordic Journal of Psychiatry	See key work search in Appendix A	To determine the association of somatic symptoms to depression.	Does ethnicity impact the presentation of somatic symptoms in patients with depression?	quantitative
Theory/ Framework	**Study Sample and Setting**	**Methods & Procedures Instruments /Means of Collecting Data**	**Study Analyses**	**Results & Findings**
None Identified	Ninety patients who were diagnosed with a major depressive episode in a Turkish hospital	Symptom Interpretation Questionnaire to assess somatic symptoms	Multiple regression analyses	There are differences in the degree of somatization among patients from varying ethnicities with major depressive disorder. More severe depression had higher degrees of somatization.
Reference Citation: Author, Journal, Date	**Database/Search Tool Keywords Used**	**Purpose of Study**	**Research Questions/ Hypotheses**	**Study Design (RCT, Qualitative, Quantitative, Mixed)**
Terre, Poston, Forest, & St. Jeor (2003). Psychotherapy and Psychosomatics	See key work search in Appendix A	To identify the predictive relationship of somatic symptoms for a future diagnosis of depression.	Do somatic complaints predict subsequent symptoms of depression?	quantitative

Theory/ Framework	Study Sample and Setting	Methods & Procedures Instruments /Means of Collecting Data	Study Analyses	Results & Findings
None Identified	464 participants from years 1, 2, and 5 of the RENO (Relationship of Energy and Nutrition to Obesity)	Center for Epidemiologic Studies Depression Scale (CES-D) and the SCL-90 somatization subscale	Multiple regression analyses	Somatic complaints are a risk factor for the future development of depressive symptoms in women in nonclinical populations.
Reference Citation: Author, Journal, Date	**Database/Search Tool Keywords Used**	**Purpose of Study**	**Research Questions/ Hypotheses**	**Study Design (RCT, Qualitative, Quantitative, Mixed)**
Vaccarino, Sills, Evans, & Kalali (2008). Journal of Affective Disorder.	See key work search in Appendix A	To characterize the relationship between somatic symptoms and depression in patients diagnosed with Major Depressive Disorder (MDD),	An increase in depression severity related to an increase in somatic symptoms.	quantitative
Theory/ Framework	**Study Sample and Setting**	**Methods & Procedures Instruments /Means of Collecting Data**	**Study Analyses**	**Results & Findings**
None Identified	2191 patients enrolled in randomized, multicenter, double-blind placebo-controlled studies for the treatment of major depressive disorder	Somatic symptoms were assessed using the Somatic Symptoms Inventory (SSI) and the Hamilton Depression Rating Scale (HAMD) was used to assess symptoms of depression.	Pearson product-moment correlations	Many somatic symptoms demonstrate good relationship between item response and the overall severity of depression. The most common somatic symptom reported by patients with MDD was 'feeling fatigued, weak, or tired all over, general feelings of malaise, and headaches
Reference Citation: Author, Journal, Date	**Database/Search Tool Keywords Used**	**Purpose of Study**	**Research Questions/ Hypotheses**	**Study Design (RCT, Qualitative, Quantitative, Mixed)**
Wong, & Fong (2015). Psychology, Health & Medicine	See key work search in Appendix A	To examine the relationship between stress, anxiety, depression, and somatic symptoms.	Are stress and somatic symptoms negatively associated with the presentation of anxiety and depression?	Quantitative
Theory/ Framework	**Study Sample and Setting**	**Methods & Procedures Instruments /Means of Collecting Data**	**Study Analyses**	**Results & Findings**

None Identified	202 Chinese Adults surveyed between August and September 2013 in Hong Kong	Data were collected from household surveys using the Patient Health Questionnaire, Perceived Stress Scale, & Hospital Anxiety and Depression Scale	Structural Equation Models were used to analyze the pathways between the different symptom and disease pathways.	Stress had a direct relationship on psychosomatic symptoms (p = .004), additionally, stress impacted anxiety, which led to psychosomatic symptoms. The presentation of anxiety was found to be associated with depression (p < .001).
Reference Citation: Author, Journal, Date	**Database/Search Tool Keywords Used**	**Purpose of Study**	**Research Questions/ Hypotheses**	**Study Design (RCT, Qualitative, Quantitative, Mixed)**
Zhou et al. (2011). Journal of Affective Disorders	See key work search in Appendix A	To examine the influence of ethnicity on the presentation of somatic symptoms in anxiety and depression.	Is distress always somaticized in China?	quantitative
Theory/ Framework	**Study Sample and Setting**	**Methods & Procedures Instruments /Means of Collecting Data**	**Study Analyses**	**Results & Findings**
None Identified	Toronto sample included 33 men and 46 women of Euro-Canadian heritage, with a mean age of 36 years (range=18 to 60, SD=10);Changsha sample included 68 men and 86women of Han Chinese heritage, with a mean age of 31 years(range=18 to 65, SD=11)	Structured Clinical Interview for DSM-IV, Axis I, Patient Version, anxiety disorder; Chinese Personality Assessment Inventory (CPAI-S); Cognitive-Somatic Anxiety Questionnaire (CSAQ)	Three-step ordinal logistic regressions	Chinese participants reported a greater tendency to emphasize somatic symptoms of depression, as compared to the Euro- Canadians. The tendency to emphasize somatic symptoms of anxiety was higher among the Euro-Canadians as compared to the Chinese participants.
Reference Citation: Author, Journal, Date	**Database/Search Tool Keywords Used**	**Purpose of Study**	**Research Questions/ Hypotheses**	**Study Design (RCT, Qualitative, Quantitative, Mixed)**
Zhao et al. (2018). Comprehensive Psychiatry	See key work search in Appendix A	To investigate the clinical characteristics of somatic symptoms of patients in China who suffer from major depressive disorder	Is there a relationship between somatic symptoms severity and MDD severity?	quantitative
Theory/ Framework	**Study Sample and Setting**	**Methods & Procedures Instruments /Means of Collecting Data**	**Study Analyses**	**Results & Findings**

None Identified	3273 patients were recruited from 16 general hospitals and 16 mental health centers in China.	The National Survey on Symptomatology of Depression (NSSD)- a customized depression disorder symptomatology questionnaires assessing the clinical characteristics of patients with MDD	Fisher's z test of proportions and chi- square tests were used to examine associations	Specific somatic complaints were seen to be associated with MDD such as insomnia (64.6%), weight loss (38.5%), low appetite (37.6%), headache (31.3%), hypo sexuality (31.0%), gastrointestinal symptom tom complaints (29.6%), and respiratory system complaints (29.6%). The presentation of somatic symptoms varied by clinic location, age, and gender
Reference Citation: Author, Journal, Date	**Database/Search Tool Keywords Used**	**Purpose of Study**	**Research Questions/ Hypotheses**	**Study Design (RCT, Qualitative, Quantitative, Mixed)**
Zhu et al. (2012). General Hospital Psychiatry	See key work search in Appendix A	This study aimed to assess the rate of depression and anxiety, and their associations with somatic symptoms,	Do somatic symptoms increase with a diagnosis of anxiety and depression?	quantitative
Theory/ Framework	**Study Sample and Setting**	**Methods & Procedures Instruments /Means of Collecting Data**	**Study Analyses**	**Results & Findings**
None Identified	2408 patients from 15 different hospitals in Guangzhou, China were recruited from August 2014 to February 2015	depression and anxiety via the Hospital Anxiety and Depression Scale (HADS), somatic symptoms via the Patient Health Questionnaire 15-Item Somatic Symptom Severity Scale (PHQ-15)	Multinomial logistic regression to assess the relationship between specific symptoms and the presentation of depression and anxiety	Patients with depression and anxiety had higher somatic symptoms and rated these symptoms as having a greater negative impact on their social functions. Stepwise multinomial logistic analyses demonstrated that females with depression and anxiety had the highest reports of somatic symptom severity.

Appendix C

SAS Programming Language

Specific Aim 1 & 2

```
libname Dis "C:\Users\cbernard\Desktop\Data";
RUN;

proc format;
value ServiceFM
1="Army"
2="Navy"
3="Marine Corps"
4="Air Force"
5="Coast Guard";

value PayGradeFM
1="Enlisted"
2="Officer";

value GenderFM
1="Male"
2="Female";

value AgeGroupFM
1="17-24 yrs."
2="25-34 yrs."
3="35-44 yrs."
4="45+ yrs.";

value RaceFM
1="Non-Hispanic White"
2="Non-White Hispanic"
3="Non-White Minority";

value SSS8FM
1="None"
2="Low Somatic Burden"
3="Medium Somatic Burden"
4="High Somatic Burden"
5="Very High Somatic Burden";

value GAD7FM
1="Minimal Anxiety"
2="Mild Anxiety"
```

```
3="Moderate Anxiety"
4="Severe Anxiety";

value PHQ9FM
1="Minimal Depression"
2="Mild Depression"
3="Moderate Depression"
4="Moderately Severe Depression"
5="Severe Depression";

value indicatorFM
0 = "None"
1="Depression Only"
2="Anxiety Only"
3="Both";
RUN;

DATA;
SET Dis.data;

*Create new variable for race;
IF minority=0 AND hispanic=0 THEN RACE=1;
ELSE IF minority=1 AND hispanic=1 THEN RACE=2;
ELSE IF minority=1 AND hispanic=0 THEN RACE=3;
ELSE RACE=.;
format RACE RaceFM.;

*Create cumulative variables for SSS8, GAD7, and PHQ9;
SSS8Total = Q33_RESPONSES_01 + Q33_RESPONSES_02 +
Q33_RESPONSES_03 + Q33_RESPONSES_04 +
Q33_RESPONSES_05 + Q33_RESPONSES_06 + Q33_RESPONSES_07 +
Q33_RESPONSES_08;

GAD7Total = Q93_RESPONSES_1 + Q93_RESPONSES_2 + Q93_RESPONSES_3
+ Q93_RESPONSES_4 +
Q93_RESPONSES_5 + Q93_RESPONSES_6 + Q93_RESPONSES_7;

PHQ9Total = Q92_RESPONSES_01 + Q92_RESPONSES_02 +
Q92_RESPONSES_03 + Q92_RESPONSES_04 +
Q92_RESPONSES_05 + Q92_RESPONSES_06 + Q92_RESPONSES_07 +
Q92_RESPONSES_08 + Q92_RESPONSES_09;

*create new variables for the ordinal scales of SSS8, GAD7, and
PHQ9 total scores;
If SSS8Total=. then SSS8Group2=.;
else if SSS8Total<4 then SSS8Group2=1;
else if 4<=SSS8Total<8 then SSS8Group2=2;
```

```
else if 8<=SSS8Total<12 then SSS8Group2=3;
else if 12<=SSS8Total<16 then SSS8Group2=4;
else SSS8Group2=5;
format SSS8Group2 SSS8FM.;

If GAD7Total=. then GAD7Group=.;
else if GAD7Total<5 then GAD7Group=1;
else if 5<=GAD7Total<10 then GAD7Group=2;
else if 10<=GAD7Total<15 then GAD7Group =3;
else GAD7Group=4;
format GAD7Group GAD7FM.;

If PHQ9Total=. then PHQ9Group=.;
else if PHQ9Total<5 then PHQ9Group=1;
else if 5<=PHQ9Total<10 then PHQ9Group=2;
else if 10<=PHQ9Total<15 then PHQ9Group=3;
else if 15<=PHQ9Total<20 then PHQ9Group=4;
else PHQ9Group=5;
format PHQ9Group PHQ9FM.;

*Create MH Indicator Variable for the presence of anxiety,
depression, or both;
If PHQ9Total=. then Depression=.;
else if PHQ9Total>=15 then Depression=1;
else Depression = 0;

If GAD7Total=. then Anxiety=.;
else if GAD7Total>=10 then Anxiety=1;
else Anxiety = 0;

If Depression=. then MHIndicator=.;
else if Anxiety=. then MHIndicator=.;
else if Depression=0 and Anxiety=0 then MHIndicator=0;
else if Depression=1 and Anxiety=0 then MHIndicator=1;
else if Depression=0 and Anxiety=1 then MHIndicator=2;
else if Depression=1 and Anxiety=1 then MHIndicator=3;
format MHIndicator indicatorFM.;


*format demographic variables;
format Q01 ServiceFM.;
format Q07_paygrade PayGradeFM.;
format Q08 GenderFM.;
format Q17_agegrp AgeGroupFM. ;
RUN;

*Specific AIM 1a-c;
```

```
*Verify Accuracy of newly created variables;
proc freq;
table RACE Depression Anxiety MHIndicator SSS8Group2 SSS8Total
PHQ9Group PHQ9Total GAD7Group GAD7Total
Q33_RESPONSES_01 Q33_RESPONSES_02 Q33_RESPONSES_03
Q33_RESPONSES_04 Q33_RESPONSES_05
Q33_RESPONSES_06 Q33_RESPONSES_07 Q33_RESPONSES_08;
RUN;

*Examine prevalence;
proc surveyfreq data=Data nomcar missing ;
weight ps_wgt;
Table
Q01 Q07_paygrade Q08 Q17_agegrp RACE SSS8Group2 GAD7Group
PHQ9Group MHIndicator
Q33_RESPONSES_01 Q33_RESPONSES_02 Q33_RESPONSES_03
Q33_RESPONSES_04 Q33_RESPONSES_05
Q33_RESPONSES_06 Q33_RESPONSES_07 Q33_RESPONSES_08
/col cl;

run;

*Specific AIM 1d and AIM 2;
* Table 2  Unadjusted analysis - weighted %, and significance of
relationship;
proc surveyfreq data=Data nomcar;
weight ps_wgt;
Table
(MHIndicator GAD7Group PHQ9Group)*SSS8Group2
/col nowt nototal wchisq;
RUN;

proc surveyfreq data=Data nomcar;
weight ps_wgt;
Table
(MHIndicator GAD7Group PHQ9Group SSS8Group2)*Q01
/col nowt nototal wchisq;
RUN;

proc surveyfreq data=Data nomcar;
weight ps_wgt;
Table
(MHIndicator GAD7Group PHQ9Group SSS8Group2)*Q07_paygrade
/col nowt nototal wchisq;
RUN;

proc surveyfreq data=Data nomcar;
```

```
weight ps_wgt;
Table
(MHIndicator GAD7Group PHQ9Group SSS8Group2)*Q08
/col nowt nototal wchisq;
RUN;

proc surveyfreq data=Data nomcar;
weight ps_wgt;
Table
(MHIndicator GAD7Group PHQ9Group SSS8Group2)*Q17_agegrp
/col nowt nototal wchisq;
RUN;

proc surveyfreq data=Data nomcar;
weight ps_wgt;
Table
(MHIndicator GAD7Group PHQ9Group SSS8Group2)*RACE
/col nowt nototal wchisq;
RUN;
```

Specific Aim 3

```
libname Dis "C:\Users\cbernard\Desktop\Data";
RUN;

proc format;
value ServiceFM
1="Army"
2="Navy"
3="Marine Corps"
4="Air Force"
5="Coast Guard";

value PayGradeFM
1="Enlisted"
2="Officer";

value GenderFM
1="Male"
2="Female";

value AgeGroupFM
1="17-24 yrs."
2="25-34 yrs."
3="35-44 yrs."
4="45+ yrs.";
```

```
value RaceFM
1="Non-Hispanic White"
2="Non-White Hispanic"
3="Non-White Minority";

value indicatorFM
0 = "None"
1="Depression Only"
2="Anxiety Only"
3="Both";
RUN;

DATA;
SET Dis.data;

*Create new variable for race;
IF minority=0 AND hispanic=0 THEN RACE=1;
ELSE IF minority=1 AND hispanic=1 THEN RACE=2;
ELSE IF minority=1 AND hispanic=0 THEN RACE=3;
ELSE RACE=.;
format RACE RaceFM.;

*Create cumulative variables for SSS8, GAD7, and PHQ9;
SSS8Total = Q33_RESPONSES_01 + Q33_RESPONSES_02 +
Q33_RESPONSES_03 + Q33_RESPONSES_04 +
Q33_RESPONSES_05 + Q33_RESPONSES_06 + Q33_RESPONSES_07 +
Q33_RESPONSES_08;

GAD7Total = Q93_RESPONSES_1 + Q93_RESPONSES_2 + Q93_RESPONSES_3
+ Q93_RESPONSES_4 +
Q93_RESPONSES_5 + Q93_RESPONSES_6 + Q93_RESPONSES_7;

PHQ9Total = Q92_RESPONSES_01 + Q92_RESPONSES_02 +
Q92_RESPONSES_03 + Q92_RESPONSES_04 +
Q92_RESPONSES_05 + Q92_RESPONSES_06 + Q92_RESPONSES_07 +
Q92_RESPONSES_08 + Q92_RESPONSES_09;

*create new variables for the ordinal scales of SSS8, GAD7, and
PHQ9 total scores;

If SSS8Total=. then SSS8Group2=.;
else if SSS8Total<4 then SSS8Group2=1;
else if 4<=SSS8Total<8 then SSS8Group2=2;
else if 8<=SSS8Total<12 then SSS8Group2=3;
else if 12<=SSS8Total<16 then SSS8Group2=4;
else SSS8Group2=5;
```

```
If GAD7Total=. then GAD7Group=.;
else if GAD7Total<5 then GAD7Group=1;
else if 5<=GAD7Total<10 then GAD7Group=2;
else if 10<=GAD7Total<15 then GAD7Group =3;
else GAD7Group=4;

If PHQ9Total=. then PHQ9Group=.;
else if PHQ9Total<5 then PHQ9Group=1;
else if 5<=PHQ9Total<10 then PHQ9Group=2;
else if 10<=PHQ9Total<15 then PHQ9Group=3;
else if 15<=PHQ9Total<20 then PHQ9Group=4;
else PHQ9Group=5;

*Create MH Indicator Variable for the presence of anxiety,
depression, or both;
If PHQ9Total=. then Depression=.;
else if PHQ9Total>=15 then Depression=1;
else Depression = 0;

If GAD7Total=. then Anxiety=.;
else if GAD7Total>=10 then Anxiety=1;
else Anxiety = 0;

If Depression=. then MHIndicator=.;
else if Anxiety=. then MHIndicator=.;
else if Depression=0 and Anxiety=0 then MHIndicator=0;
else if Depression=1 and Anxiety=0 then MHIndicator=1;
else if Depression=0 and Anxiety=1 then MHIndicator=2;
else if Depression=1 and Anxiety=1 then MHIndicator=3;
format MHIndicator indicatorFM.

/*format demographic variables*/
format Q01 ServiceFM.;
format Q07_paygrade PayGradeFM.;
format Q08 GenderFM.;
format Q17_agegrp AgeGroupFM. ;
RUN;

*Unadjusted Model of SSS8 and anxiety symptoms using nominal
model;
proc surveylogistic data=Data nomcar ;
class
SSS8Group2 (REF='3')
/param=glm ;
model GAD7Group(descending)= SSS8Group2  / link=glogit;
weight ps_wgt;
```

```
Run;

 *Unadjusted model of SSS8 and depression symptoms using nominal
model;
proc surveylogistic data=Data nomcar ;
class
SSS8Group2 (REF='3')
/param=glm ;
model PHQ9Group(descending)= SSS8Group2 /link=glogit;
weight ps_wgt;
Run;
*Unadjusted Model of SSS8 and anxiety symptoms using ordinal
model;

proc surveylogistic data=Data nomcar ;
class
SSS8Group2 (REF='3')
/param=glm ;
model GAD7Group(descending)= SSS8Group2;
weight ps_wgt;
Run;

 *Unadjusted model of SSS8 and depression symptoms using ordinal
model;
proc surveylogistic data=Data nomcar ;
class
SSS8Group2 (REF='3')
/param=glm ;
model PHQ9Group(descending)= SSS8Group2;
weight ps_wgt;
Run;

*Unadjusted model of GAD7 and Service;
proc surveylogistic data=Data nomcar;
class
Q01(REF='Army')
/param=glm;
model GAD7Group(descending)= Q01;
weight ps_wgt;
Run;

*Unadjusted model of GAD7 and PayGrade;
proc surveylogistic data=Data nomcar;
class
Q07_paygrade (REF='Enlisted')
/param=glm;
model GAD7Group(descending)= Q07_paygrade;
```

```
weight ps_wgt;
Run;

*Unadjusted model of GAD7 and Gender;
proc surveylogistic data=Data nomcar;
class
Q08 (REF='Male')
/param=glm;
model GAD7Group(descending)= Q08;
weight ps_wgt;
Run;

*Unadjusted model of GAD7 and Age;
proc surveylogistic data=Data nomcar;
class
Q17_agegrp (REF='17-24 yrs.')
/param=glm;
model GAD7Group(descending)= Q17_agegrp;
weight ps_wgt;
Run;

*Unadjusted model of GAD7 and Race;
proc surveylogistic data=Data nomcar;
class
RACE (REF= 'Non-Hispanic White')
/param=glm;
model GAD7Group(descending)= RACE;
weight ps_wgt;
Run;

*Unadjusted model of PHQ9 and Service;
proc surveylogistic data=Data nomcar;
class
Q01(REF='Army')
/param=glm;
model PHQ9Group(descending)= Q01;
weight ps_wgt;
Run;

*Unadjusted model of PHQ9 and PayGrade;
proc surveylogistic data=Data nomcar;
class
Q07_paygrade (REF='Enlisted')
/param=glm;
model PHQ9Group(descending)= Q07_paygrade;
weight ps_wgt;
Run;
```

```
*Unadjusted model of PHQ9 and Gender;
proc surveylogistic data=Data nomcar;
class
Q08 (REF='Male')
/param=glm;
model PHQ9Group(descending)= Q08;
weight ps_wgt;
Run;

*Unadjusted model of PHQ9 and Age;
proc surveylogistic data=Data nomcar;
class
Q17_agegrp (REF='17-24 yrs.')
/param=glm;
model PHQ9Group(descending)= Q17_agegrp;
weight ps_wgt;
Run;

*Unadjusted model of PHQ9 and Race;
proc surveylogistic data=Data nomcar;
class
RACE (REF= 'Non-Hispanic White')
/param=glm;
model PHQ9Group(descending)= RACE;
weight ps_wgt;
Run;

*Adjusted MLR of Y=GAD7Group X=SSS8 using ordinal model;
proc surveylogistic data=Data nomcar;
class
Q01 (REF='Army')
Q07_paygrade (REF='Enlisted')
Q08 (REF='Male')
Q17_agegrp (REF = '17-24 yrs.')
RACE (REF = 'Non-Hispanic White')
SSS8Group2 (REF='3')
/param=glm;
model GAD7Group(descending) = Q01 Q07_paygrade Q08 Q17_agegrp
RACE SSS8Group2;
weight ps_wgt;
Run;

*Adjusted MLR of Y=PHQ9Group X=SSS8 using ordinal model;
proc surveylogistic data=Data nomcar;
class
Q01 (REF='Army')
```

```
Q07_paygrade (REF='Enlisted')
Q08 (REF='Male')
Q17_agegrp (REF = '17-24 yrs.')
RACE (REF = 'Non-Hispanic White')
SSS8Group2 (REF='3')
/param=glm;
model  PHQ9Group(descending) = Q01 Q07_paygrade Q08 Q17_agegrp
RACE SSS8Group2;
weight ps_wgt;
RUN;

*Unadjusted Model of MHI and SSS8;
proc surveylogistic data=Data nomcar ;
class
SSS8Group2 (REF='3')
/param=glm ;
model MHIndicator(REF= 'None')= SSS8Group2 /link=glogit;
weight ps_wgt;
Run;

*Unadjusted model of MHI and Service;
proc surveylogistic data=Data nomcar;
class
Q01(REF='Army')
/param=glm;
model MHIndicator (REF= 'None')= Q01/ link=glogit;
weight ps_wgt;
Run;

*Unadjusted model of MHI and PayGrade;
proc surveylogistic data=Data nomcar;
class
Q07_paygrade (REF='Enlisted')
/param=glm;
model MHIndicator (REF= 'None')= Q07_paygrade / link=glogit;
weight ps_wgt;
Run;

*Unadjusted model of MHI and Gender;
proc surveylogistic data=Data nomcar;
class
Q08 (REF='Male')
/param=glm;
model MHIndicator (REF= 'None')= Q08 / link=glogit;
weight ps_wgt;
Run;
```

```
*Unadjusted model of MHI and Age;
proc surveylogistic data=Data nomcar;
class
Q17_agegrp (REF='17-24 yrs.')
/param=glm;
model MHIndicator (REF= 'None')= Q17_agegrp / link=glogit;
weight ps_wgt;
Run;

*Unadjusted model of MHI and Race;
proc surveylogistic data=Data nomcar;
class
RACE (REF= 'Non-Hispanic White')
/param=glm;
model MHIndicator (REF= 'None')= RACE / link=glogit;
weight ps_wgt;
Run;

*Adjusted model of MHI and SSS8;
proc surveylogistic data=Data nomcar;
class
SSS8Group2 (REF='3')
Q01 (REF='Army')
Q07_paygrade (REF='Enlisted')
Q08 (REF='Male')
Q17_agegrp (REF = '17-24 yrs.')
RACE (REF= 'Non-Hispanic White')
/param=glm;
model MHIndicator (REF= 'None')=  SSS8Group2 Q01 Q07_paygrade
Q08 Q17_agegrp RACE / link=glogit;
weight ps_wgt;
Run;
```

Appendix D

Table 4: Characteristics of Active-Duty Service Members in the United States Military: HRBS, 2015 (n= 16,699)

Characteristic	n (weighted %)	95% CL for % (LUL, UCL)
Anxiety Symptom Severity		
Missing	1,492 (11.1)	10.1, 12.1
Mild Anxiety	9,523 (51.8)	50.2, 53.4
Moderate Anxiety	3,625 (21.2)	19.8, 22.5
Severe Anxiety	2,059 (16.0)	14.7, 17.2
Depression Symptom Severity		
Missing	1,468 (10.9)	9.9, 11.9
Mild Depression	4,619 (25.9)	24.4, 27.3
Moderate Depression	6,477 (34.3)	32.8, 35.8
Moderately Severe Depression	2,378 (14.4)	13.2, 15.5
Severe Depression	1,757 (14.6)	13.4, 15.8
Mental Health Indicator		
Missing	1,498 (11.2)	10.2, 12.2
None	8,879 (48.2)	46.6, 49.8
Probable Depression Only	541 (3.5)	2.9, 4.1
Probable Anxiety Only	2,098 (11.7)	10.7, 12.8
Both	3,583 (25.3)	23.9, 26.8
Somatic Symptom Severity		
Missing	10 (0.1)	0.0 , 0.2
Medium Somatic Burden	7,585 (45.3)	43.6, 46.9
High Somatic Burden	5,962 (33.6)	32.1, 35.1
Very High Somatic Burden	3,142 (21.1)	19.7, 22.4
Branch of service		
Army	3,197 (37.3)	35.6, 39.0
Navy	3,016 (23.4)	22.1, 24.7
Marine Corps	2,184 (14.0)	12.9, 15.1
Air Force	4,150 (22.3)	21.3, 23.3
Coast Guard	4,152 (3.0)	2.9, 3.1
Rank		
Enlisted	10,204 (84.1)	83.5, 85.1
Officer	6,495 (15.9)	15.2, 16.5
Gender		
Male	10,368 (84.4)	83.7, 85.1
Female	6,331 (15.6)	14.9, 16.3
Age		

Missing	17 (0.1)	0.0, 0.1
17-24 yrs.	1987 (28.7)	27.1, 30.3
25-34 yrs.	6116 (41.9)	40.3, 43.5
35-44 yrs.	6089 (22.5)	21.3, 23.7
45+ yrs.	2490 (6.8)	6.2, 7.4
Race		
Missing	34 (0.1)	0.1, 0.2
Non-Hispanic White	10,869 (58.3)	56.7, 59.9
Non-White Hispanic	2,083 (16.5)	15.2, 17.8
Non-White Minority	3,713 (25.1)	23.7, 26.5

Appendix E

Table 5: Prevalence of Specific Somatic Symptoms in Active-Duty Service Members in the United States Military: HRBS, 2015 (n= 16,699)

In the Past 30 days, how much were you bothered by:	n (weighted %)	95% CL for % (LUL, UCL)
Q1. Stomach or Bowel Problems		
Missing	4 (0.05)	0.0, 0.1
A little bit (1)	11,292 (70.5)	69.1, 71.9
Somewhat (2)	3,939 (20.8)	19.5, 22.1
Quite a bit (3)	1,464 (8.7)	7.8, 9.5
Q2. Back Pain		
Missing	1 (0.0)	0.0, 0.0
A little bit (1)	7,982, (46.5)	44.9, 48.1
Somewhat (2)	5,436 (31.5)	30.0, 33.0
Quite a bit (3)	3,280 (22.0)	20.6, 22.4
Q3. Pain in Arms, Legs, or Joints		
Missing	1 (0.0)	0.0, 0.0
A little bit (1)	7,982 (46.5)	44.9, 48.1
Somewhat (2)	5,436 (31.4)	30.0, 33.0
Quite a bit (3)	3,280 (22.0)	20.6, 23.4
Q4. Headaches		
Missing	2 (0.0)	0.0, 0.0
A little bit (1)	9,186 (56.2)	54.7, 57.9
Somewhat (2)	5,671 (32.0)	30.4, 33.3
Quite a bit (3)	1,840 (11.8)	10.8, 12.8
Q5. Chest Pain or Shortness of Breath		
Missing	4 (0.0)	0.0, 0.0
A little bit (1)	14,266 (82.7)	81.4, 84
Somewhat (2)	1,810 (12.6)	11.5, 13.7
Quite a bit (3)	619 (4.7)	4.0, 5.3
Q6. Dizziness		
Missing	6 (0.0)	0.0, 0.0
A little bit (1)	14,924 (82.5)	81.3, 83.7
Somewhat (2)	2,155 (13.0)	12.0, 14.0
Quite a bit (3)	614 (4.4)	3.8, 5.1
Q7. Feeling Tired or Having Low Energy		
Missing	2 (0.0)	0.0, 0.0
A little bit (1)	5,746 (35.9)	34.3, 37.5

Somewhat (2)	7,427 (40.9)	39.3, 42.4
Quite a bit (3)	3,524 (23.2)	21.9, 24.6
Q8. Trouble Sleeping		
Missing	1 (0.0)	0.0, 0.0
A little bit (1)	6,991 (40.0)	38.4, 41.6
Somewhat (2)	6,119 (35.0)	33.5, 36.5
Quite a bit (3)	3,588 (25.0)	23.6, 26.4

Appendix F

Table 6: Prevalence of Somatic Symptoms by Active-Duty Service Members Characteristics: HRBS, 2015 (n= 16,699)

	Somatic Symptom Severity						
	Medium Somatic Burden		High Somatic Burden		Very High Somatic Burden		*p* value
Characteristic	Frequency	Weighted % (SE)	Frequency	Weighted % (SE)	Frequency	Weighted % (SE)	
Branch of service							
Army	1,058	40.0 (1.7)	1,197	34.5 (1.6)	939	25.5 (1.4)	<.0001
Navy	1,367	45.8 (1.6)	1,066	34.6 (1.5)	583	19.7 (1.3)	
Marine Corps	866	41.3 (2.1)	824	32.9 (1.9)	491	25.8 (1.8)	
Air Force	2,102	54.8 (1.1)	1,419	31.6 (1.0)	627	13.6 (0.7)	
Coast Guard	2,194	55.6 (0.9)	1.456	33.3 (0.8)	502	11.2 (0.5)	
Rank							
Enlisted	4,045	43.4 (1.0)	3,814	33.9 (0.9)	2,339	22.7 (0.8)	<.0001
Officer	3,542	55.6 (0.8)	2,148	32.2 (0.8)	803	12.3 (0.6)	
Gender							
Male	5,189	47.5 (1.0)	3,539	32.6 (0.9)	1,635	20.0 (0.8)	<.0001
Female	2,396	33.4 (0.9)	2,423	39.4 (1.0)	1,507	27.2 (0.9)	
Age							
17-24 yrs.	1,016	51.9 (1.8)	647	30.1 (1.7)	323	18.0 (1.4)	<.0001
25-34 yrs.	3,204	48.3 (1.3)	1,988	32.0 (1.2)	922	19.7 (1.1)	
35-44 yrs.	2,462	35.5 (1.3)	2,346	40.2 (1.4)	1,277	24.3 (1.2)	
45+ yrs.	894	30.8 (1.7)	977	37.0 (1.9)	616	32.2 (2.1)	

Race							
Non-Hispanic White	5,235	46.9 (1.0)	3,906	34.3 (1.0)	1,720	18.8 (0.8)	<.0030
Non-White Hispanic	864	44.0 (2.2)	728	32.6 (2.0)	491	23.4 (1.8)	
Non-White Minority	1,473	42.4 (1.7)	1,314	32.7 (1.5)	924	24.9 (1.4)	

Appendix G

Table 7: Prevalence of Anxiety Symptoms by Active-Duty Service Members Characteristics: HRBS, 2015 (n= 16,699)

	Anxiety Symptom Severity						
	Mild Anxiety		Moderate Anxiety		Severe Anxiety		*p* value
Characteristic	Frequency	Weighted % (SE)	Frequency	Weighted % (SE)	Frequency	Weighted % (SE)	
Branch of service							
Army	1,607	55.7 (1.7)	776	24.7 (1.5)	555	19.6 (1.4)	<.0001
Navy	1,626	54.0 (1.7)	702	25.8 (1.5)	415	20.2 (1.4)	
Marine Corps	1,112	48.8 (2.2)	534	26.3 (1.9)	343	24.9 (2.0)	
Air Force	2,650	72.1 (1.1)	690	18.6 (0.9)	325	9.3 (0.7)	
Coast Guard	2,528	65.8 (0.9)	923	23.4 (0.8)	421	10.8 (0.5)	
Pay Grade							
Enlisted	5,312	56.0 (1.0)	2,326	24.4 (0.9)	1,524	19.6 (0.8)	<.0001
Officer	4,211	69.5 (0.8)	1,299	21.0 (0.7)	535	9.5 (0.5)	
Gender							
Male	6,224	59.7 (1.0)	2,141	23.1 (0.9)	1,110	17.2 (0.8)	<.0001
Female	3,299	50.0 (1.0)	1,484	27.9 (0.0)	949	22.0 (0.9)	
Age							
17-24 yrs.	1,042	58.2 (1.9)	403	22.1 (1.6)	300	19.8 (1.5)	<.6411
25-34 yrs.	3,438	57.5 (1.4)	1,319	24.9 (1.2)	757	17.6 (1.1)	
35-44 yrs.	3,512	59.3 (1.4)	1,375	23.8 (1.2)	735	16.9 (1.1)	
45+ yrs.	1,522	59.2 (2.1)	524	24.4 (1.8)	266	16.4 (2.0)	
Race							
Non-Hispanic White	6,376	57.8, 1.1)	2,390	24.4, 0.9)	1,239	17.8 (0.9)	<.5082

Non-White Hispanic	1,100	56.3, 2.4)	438	24.5, 2.1)	301	19.2 (1.9)	
Non-White Minority	2,027	60.5, 1.7)	793	21.9, 1.4)	516	17.5 (1.4)	

Appendix H

Table 8: *Prevalence of Depression Symptoms by Active-Duty Service Members Characteristics: Health-Related Behaviors Survey, 2015 (n= 16,699)*

	Depression Symptom Severity								
	Mild Depression		Moderate Depression		Moderately Severe Depression		Severe Depression		*p* value
Characteristic	Frequency	Weighted % (SE)	Frequency	Weighted % (SE)	Frequency	Weighted % (SE)	Frequency	Weighted % (SE)	
Branch of service									
Army	717	26.1 (1.6)	1,144	37.0 (1.7)	574	17.2 (1.3)	507	19.6 (1.4)	<.0001
Navy	762	26.7 (1.5)	1,178	38.6 (1.6)	445	16.9 (1.3)	363	17.8 (1.4)	
Marine Corps	511	23.3 (1.8)	847	38.1 (2.1)	363	18.6 (1.7)	271	20.0 (1.8)	
Air Force	1,388	39.4 (1.2)	1,567	40.6 (1.2)	437	12.1 (0.7)	285	7.9 (0.7)	
Coast Guard	1,241	33.3 (0.9)	1,741	43.7 (1.0)	559	14.2 (0.6)	331	8.8 (0.5)	
Rank									
Enlisted	2,557	27.9 (0.9)	3,677	37.3 (1.0)	1,607	16.6 (0.7)	1,339	18.1 (0.8)	<.0001
Officer	2,062	34.7 (0.8)	2,800	44.6 (0.9)	771	13.4 (0.6)	418	7.3 (0.5)	
Gender									
Male	3,144	30.2 (0.9)	4,043	38.4, 1.0)	1,361	15.6 (0.7)	940	15.8 (0.8)	<.0001
Female	1,475	22.5 (0.8)	2,434	39.0 (1.0)	1,017	18.8 (0.8)	817	19.7 (0.9)	
Age									
17-24 yrs.	535	30.2 (1.8)	691	37.4 (1.9)	263	14.0 (1.3)	263	18.4 (1.5)	<.3706
25-34 yrs.	1,744	28.9 (1.2)	2,286	38.1 (1.3)	858	17.4 (1.1)	634	15.8 (1.1)	
35-44 yrs.	1,625	27.9 (1.3)	2,507	41.1 (1.4)	887	15.9 (1.1)	607	15.2 (1.1)	
45+ yrs.	711	28.6 (1.7)	988	37.5 (1.9)	367	17.5 (1.8)	251	16.3 (1.9)	

Race									
Non-Hispanic White	3,075	29.0 (1.0)	4,427	39.2 (1.0)	1,491	16.1 (0.8)	1,026	15.7 (0.9)	<.9211
Non-White Hispanic	550	28.4 (2.1)	703	37.1 (2.4)	334	17.0 (1.7)	259	17.5 (1.8)	
Non-White Minority	989	29.4 (1.6)	1,331	37.7 (1.7)	548	15.7 (1.3)	471	17.1 (1.3)	

Appendix I

Table 9: Prevalence of Mental Health Indicators by Active-Duty Service Members Characteristics: HRBS, 2015 (n= 16,699)

	Mental Health Indicator								
	None		Probable Depression Only		Probable Anxiety Only		Both		*p* value
Characteristic	Frequency	Weighted % (SE)	Frequency	Weighted % (SE)	Frequency	Weighted % (SE)	Frequency	Weighted % (SE)	
Branch of service									
Army	1,487	51.4 (1.7)	120	4.3 (0.7)	371	11.7 (1.1)	959	32.6 (1.6)	<.0001
Navy	1,521	49.6 (1.7)	104	4.4 (0.7)	415	15.8 (1.2)	701	30.3 (1.6)	
Marine Corps	1,041	45.7 (2.2)	71	3.0 (0.7)	315	15.6 (1.6)	561	35.6 (2.1)	
Air Force	2,515	68.6 (1.1)	135	3.6 (0.4)	432	11.5 (0.8)	583	16.3 (0.9)	
Coast Guard	2,415	62.8 (0.9)	111	3.0 (0.3)	565	14.2 (0.6)	779	20.0 (0.7)	
Rank									
Enlisted	4,953	51.9 (1.0)	357	4.1 (0.4)	1,267	13.3 (0.7)	2,580	30.7 (1.0)	<.0001
Officer	4,026	66.6 (0.8)	184	2.9 (0.3)	831	12.7 (0.6)	1,003	17.8 (0.7)	
Gender									
Male	5,914	55.8 (1.1)	307	3.9 (0.4)	1,261	12.8 (0.7)	1,989	27.5 (0.9)	<.0001
Female	3,065	46.1 (1.0)	234	4.0 (0.4)	837	15.5 (0.8)	1,594	34.5 (1.0)	
Age									
17-24 yrs.	981	54.4 (1.9)	60	3.8 (0.8)	239	13.2 (1.3)	463	28.6 (1.7)	<.7402
25-34 yrs.	3,249	53.5 (1.4)	187	4.0 (0.6)	777	13.5 (0.9)	1,298	29.0 (1.3)	
35-44 yrs.	3,316	55.4 (1.4)	196	4.0 (0.6)	812	13.6 (1.0)	1,297	27.1 (1.3)	
45+ yrs.	1,425	55.3 (2.1)	97	4.0 (0.7)	269	10.8 (1.1)	521	30.0 (2.2)	

Race									
Non-Hispanic White	6,049	54.5 (1.1)	325	3.2 (0.4)	1,443	13.6 (0.7)	2,186	28.6 (1.0)	<.1436
Non-White Hispanic	1,013	51.0 (2.4)	87	5.3 (1.2)	237	14.7 (1.8)	502	29.0 (2.1)	
Non-White Minority	1,898	55.8 (1.8)	128	4.8 (0.8)	416	11.4 (1.1)	890	28.1 (1.6)	

Appendix J

Table 10: Prevalence and Relationship between Somatic Symptoms and Anxiety, Depression: HRBS, 2015 (n= 16,699)

	Somatic Symptom Severity						
	Medium Somatic Burden		High Somatic Burden		Very High Somatic Burden		*p* value
Characteristic	Frequency	Weighted % (SE)	Frequency	Weighted % (SE)	Frequency	Weighted % (SE)	
Anxiety Symptom Severity							<.0001
Mild Anxiety	5,752	80.3 (1.1)	3,214	47.5 (1.4)	556	21.2 (1.7)	
Moderate Anxiety	952	14.7 (0.9)	2,065	32.9 (1.3)	608	27.2 (1.9)	
Severe Anxiety	208	5.0 (0.7)	916	19.6 (1.1)	935	51.6 (2.2)	
Depression Symptom Severity							
Mild Depression	3,623	50.1 (1.3)	831	13.2 (0.9)	165	7.8 (1.1)	<.0001
Moderate Depression	2,787	39.2 (1.3)	3,196	45.1 (1.3)	493	19.3 (1.6)	
Moderately Severe Depression	382	7.2 (0.7)	1,428	24.5(1.2)	568	20.5 (1.7)	
Severe Depression	127	3.3 (0.6)	755	17.2 (1.1)	875	52.4 (2.2)	

Appendix K

Table 11: Unadjusted Nominal Odds Ratio of Anxiety, Depression, and Somatic Symptom Severity: HRBS, 2015 (n= 16,699)

	Anxiety Symptom Severity				
	Moderate		Severe		F Value; Pr > F
Characteristic	Odds Ratio	95% CL (UL, LL)	Odds Ratio	95% CL (UL, LL)	
Somatic Symptom Burden					160.86; *p*<.0001
Medium	1		1	0	
High	3.7	3.0; 4.5	6.3	4.9; 8.1	
Very High	5.0	3.6; 6.9	33.0	23.6; 46.1	

	Depression Symptom Severity						
	Moderate		Moderately Severe		Severe		F Value; Pr > F
Characteristic	Odds Ratio	95% CL (UL, LL)	Odds Ratio	95% CL (UL, LL)	Odds Ratio	95% CL (UL, LL)	
Somatic Symptom Burden							142.65; *p*<.0001
Medium	1		1		1		
High	4.2	3.5; 5.2	11.6	8.7; 15.6	14.0	9.3; 21.1	
Very High	3.8	2.7; 5.3	21.8	14.9; 31.9	102.2	64.9; 161,0	

Appendix L

Table 12: Unadjusted Ordinal Odds Ratio of Somatic Symptom Burden, Anxiety Symptom Severity, and Demographic Variables: HRBS, 2015 (n= 16,699)

	Anxiety Symptom Severity		F Value; Pr > F
Characteristic	Odds Ratio	95% CL (UL, LL)	
Somatic Symptom Burden			322.41; *p*<.0001
Medium	1		
High	3.9	3.2; 4.6	
Very High	15.9	12.9; 19.7	
Service Branch			46.71; *p*<.0001
Army	1		
Navy	1.1	0.9; 1.3	
Marine Corps	1.3	1.1; 1.7	
Air Force	0.5	0.4; 0.6	
Coast Guard	0.6	0.5; 0.7	
Pay Grade			125.90; *p*<.0001
Enlisted	1		
Officer	0.5	0.5; 0.6	
Gender			40.90; *p*<.0001
Male	1		
Female	1.4	1.3; 1.6	
Age			0.43; *p*=.7303
17-24 yrs.	1		
25-34 yrs.	1.0	0.8; 1.2	
35-44 yrs.	0.9	0.7; 1.1	
45+ yrs.	0.9	0.7; 1.2	
Race			1.05; *p*=.3485
Non-Hispanic White	1		
Non-White Hispanic	1.1	0.9; 1.3	
Non-White Minority	0.9	0.8; 1.1	

Appendix M

Table 13: Unadjusted Ordinal Odds Ratio of Somatic Symptom Burden, Depression Symptom Severity, and Demographic Variables: HRBS, 2015 (n= 16,699)

	Depression Symptom Severity		F Value; Pr > F
Characteristic	Odds Ratio	95% CL (UL, LL)	
Somatic Symptom Burden			430.35; *p*<.0001
Medium	1		
High	5.2	4.4; 6.1	
Very High	23.9	19.3; 29.6	
Service Branch			41.47; *p*<.0001
Army	1		
Navy	0.9	0.8; 1.1	
Marine Corps	1.1	0.9; 1.3	
Air Force	0.5	0.5; 0.7	
Coast Guard	0.6	0.5; 0.7	
Pay Grade			104.69; *p*<.0001
Enlisted	1		
Officer	0.6	0.5; 0.7	
Gender			39.55; *p*<.0001
Male	1		
Female	1.4	1.3; 1.6	
Age			0.08; *p*=.9722
17-24 yrs.	1		
25-34 yrs.	1.0	0.9; 1.2	
35-44 yrs.	1.0	0.8; 2.2	
45+ yrs.	1.0	0.8; 1.3	
Race			0.35; *p*=.7047
Non-Hispanic White	1		
Non-White Hispanic	1.1	0.9; 1.3	
Non-White Minority	1.0	0.9; 1.2	

Appendix N

Table 14: Adjusted Ordinal Odds Ratio of Anxiety, Depression, and Somatic Symptom Severity: HRBS, 2015 (n= 16,699)

	Anxiety Symptom Severity		F Value; Pr > F
Characteristic	Odds Ratio	95% CL (UL, LL)	
Somatic Symptom Burden			293.85; *p*<.0001
Medium	1		
High	3.9	3.2; 4.7	
Very High	16.3	13.0; 20.5	

	Depression Symptom Severity		F Value; Pr > F
Characteristic	Odds Ratio	95% CL (UL, LL)	
Somatic Symptom Burden			393.56; *p*<.0001
Medium	1		
High	5.4	4.5; 6.3	
Very High	24.6	19.6; 31.0	

Appendix O

Table 15: Adjusted Odds Ratio Mental Health Indicators and Somatic Symptom Severity: HRBS, 2015 (n= 16,699)

	Mental Health Indicators						
	Probable Anxiety Only		Probable Depression Only		Both		F Value; Pr > F
Characteristic	Odds Ratio	95% CL (UL, LL)	Odds Ratio	95% CL (UL, LL)	Odds Ratio	95% CL (UL, LL)	
Somatic Symptom Burden							104.90; *p*<.0001
Medium	1		1		1		
High	2.9	2.3, 3.7	5.6	3.4, 9.2	6.8	5.2, 8.8	
Very High	3.8	2.7, 5.3	9.4	5.3, 16.9	34.1	25.3, 46.1	
Branch of service							9.62; *p*<.0001
Army	1		1		1		
Navy	1.5	1.1, 2.0	1.2	0.8, 1.0	1.2	0.9, 1.5	
Marine Corps	1.6	1.1, 2.2	0.8	0.4, 1.6	1.2	0.8, 1.7	
Air Force	0.8	0.0, 1.0	0.7	0.5, 1.2	0.4	0.3, 0.6	
Coast Guard	1.1	0.8, 1.4	0.8	0.5, 1.2	0.7	0.6, 0.9	
Pay Grade							8.96; *p*<.0001
Enlisted	1		1		1		
Officer	0.8	0.8, 1.0	0.7	0.5, 1.0	0.6	0.5, 0.8	
Gender							5.06; *p*<.0001
Male	1		1		1		
Female	1.4	1.1, 1.6	1.0	0.7, 1.3	1.2	1.1, 1.5	
Age							3.28; *p*<.0001
17-24 yrs.	1		1		1		
25-24 yrs.	1.1	0.8, 1.5	1.0	0.6, 1.8	1.1	0.8, 1.4	
35-44 yrs.	0.9	0.7, 1.3	0.7	0.4, 1.4	0.7	0.5, 0.9	
45+ yrs.	0.7	0.5, 1.0	0.6	0.3, 1.3	0.6	0.4, 0.8	
Race							2.71; 0.0123
Non-Hispanic White	1		1		1		

Non-White Hispanic	1.1	0.8, 1.5	1.7	1.0, 2.8	0.9	0.7, 1.2	
Non-White Minority	0.7	0.6, 0.9	1.3	0.8, 2.0	0.7	0.6, 0.9	