RELATIONSHIPS AMONG STRESS, FOOD CHOICE, AND BODY MASS INDEX IN AIR FORCE PERSONNEL

by

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ABSTRACT

Title of Thesis: The Relationships Among Perceived Stress, Food Choice, and Body Mass Index in Air Force Personnel

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Research has shown that perceived stress and its associated metabolic changes contribute to the development of obesity (Bose, Olivan, & Laferrere, 2009). However, few studies have explored the contributory role of food choice on the relationship between perceived stress and weight status. Active duty personnel (N = 192) stationed at Andrews AFB underwent height and weight assessments and completed an anonymous survey evaluating levels of perceived stress, food choice, and weight status. The majority of participants were enlisted (90.5%), active duty (80.2%), overweight or obese (73%), Caucasian (64.1%) men (80.6%). Approximately half of the respondents appraised their lives as stressful, reporting an average of 13.16 (SD = 6.56) on the Perceived Stress Scale (clinical cutoff = 13). However, there was no significant association between perceived stress and body mass index (BMI; kg/m^2). Though perceived stress and the variety of foods reportedly consumed (e.g., hamburgers, salads) were not associated with BMI, there are important implications for the continued scientific evaluation and prevention of overweight and obesity in military personnel through improving food choice decisions during reported periods of perceived stress in real-time.

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CHAPTER 1: Literature Review

STRESS AND THE STRESS RESPONSE

Stress is defined as "the generalized, non-specific aspects of dealing with environmental change, demand, and/or threat that overwhelms the body's compensatory abilities to maintain homeostasis" (Cannon, 1929; Mason, 1975; Selye, 1976). Characterized as *eustress* (healthy, fulfilling stress) or *distress* (anxiety-provoking, maladaptive stress) experienced as *acute* (short in duration) or *chronic* (occurring daily), the broad effects of stress on diverse bodily systems and behaviors and its seemingly inevitable presence in everyday life makes stress an important mediator of health-behavior relationships (Baum & Posluszny, 1999). Acute stress, the momentary disruption of the body's homeostasis, can be psychologically and physiologically stimulating (e.g., riding a rollercoaster), while chronic, prolonged stress has been shown to have deleterious effects on one's health.

Selye (1946) described chronic alterations in hormonal responses and abnormal changes in several tissues as *diseases of adaptation*, which can ultimately lead to destructive and pathogenic responses to stress and may cause or exacerbate several disease states, including many of the diseases implicated as leading causes of death in the United States, such as cardiovascular disease and some infectious diseases (Black & Garbutt, 2002; Kiecolt-Glaser, McGuire, Robles, & Glaser, 2002). More specifically, studies have demonstrated that the effects of stress on inflammatory and immune processes influence coronary artery disease, depression, autoimmune disorders (e.g., lupus, multiple sclerosis), some cancers, and human immunodeficiency virus progression (Pereira et al., 2003; Vedhara & Irwin, 2005). Furthermore, stress-induced, chronic inflammation has been identified as being important in the functional decline that leads to frailty, disability, and untimely death (Hamerman, 1999; Taaffe, Harris, Ferrucci, Rowe, & Seeman, 2000).

Nonspecific responses to stressors (e.g., noise, pain, malnutrition, trauma, obesity, and responses to life events) progress through three successive stages referred to as the *general adaptation syndrome* (GAS) (Selye, 1946). The *alarm* stage commences when a stressor triggers the actions of the hypothalamus (the area of the brain plays a vital role in maintaining homeostasis and functions as the control center for many autonomic functions of the peripheral nervous system) and the sympathetic nervous system (SNS) (e.g., fight-or-flight response). The stage of *resistance or adaptation* activates the hypothalamic-pituitary-adrenal (HPA) axis and behavioral and physiological processes the body consistently musters in its attempts to reestablish homeostasis. If the body achieves a level of adaptation, a new but altered steady state (*homeostasis*) is achieved in which the body adopts a reversible functional and structural response to more severe physiologic stress and some pathologic stimuli (Kumar, Abbas, Fausto, & Aster, 2010). The final stage, *exhaustion*, occurs if the stress continues despite physiological attempts to adapt to the stressors, ultimately resulting in the impairment of the immune response, heart failure, and other deleterious health outcomes (Forshee, Clayton, & McCance, 2010; Selye, 1946).

The stress response has been described as nonspecific biological and behavioral changes, such as heightened cardiovascular and respiratory function which accompany the appraisal and/or emotional arousal to stressors (Baum & Posluszny, 1999). This response is initiated by the central nervous system (CNS) and the endocrine system when corticotropin-releasing hormone (CRH) is released from the hypothalamus, the SNS, the pituitary gland, and the adrenal gland (Forshee et al., 2010). The physiologic origins of the stress response depend on whether the stressor is perceived or existent. Perceived stressors elicit an anticipatory response that typically commences in the limbic system of the brain, which is the area responsible for emotions and cognition (Dallman, 2010; Forshee et al., 2010; Haber & Calzavara, 2009). This system indirectly elicits an endocrine stress response and a central response by stimulating neural pathways responsible for receiving sensory information and stimulating the locus coeruleus, the nucleus in the pons (a component of the brainstem) involved with physiological responses to stress. The locus coeruleus releases the catecholamine norepinephrine, promoting arousal, increased vigilance, increased anxiety, and other protective affective responses (Forshee et al., 2010). Reactive responses elicited by bona fide stressors (e.g., final exams) can commence either in the limbic system or in regions of the brain receiving specific sensory information relayed to the paraventricular nucleus of the hypothalamus, stimulating the locus coeruleus and both central and endocrine stress responses (Forshee et al., 2010).

The aforementioned adverse responses to stress can lead to a cascade of adverse effects such as metabolic and cardiovascular alterations, compromised growth and tissue repair and immunosuppression (Johnson, Kamilaris, Chrousos, & Gold, 1992). Due to the decade of physically and psychologically demanding military combat and contingency operations overseas, the Armed Forces have been particularly susceptible to the deleterious effects of sustained stress.

STRESS AND THE ARMED FORCES

The demands of the military milieu are such that many stressors are inherent. Due to ongoing demand reduction efforts, operational duties have increased, creating an environment in which higher levels of stress have become pervasive among all military personnel (Friedman & Preble, 2010). More than 30% of military personnel reported experiencing a "great deal of stress", and this perception has been identified as a significant occupational hazard in the military (Bray et al., 2003). Combat missions, exposure to heavy casualties, deployment to a war zone, and unexpected mobilizations of Reserve units have been correlated with higher levels of psychological stress (Blood & Gauker, 1993; Perconte, Wilson, Pontius, Dietrick, & Spiro, 1993; Pflanz & Sonnek, 2002; Yerkes, 1993). For example, military healthcare workers exposed to severe burn injuries and Navy divers recovering casualties from the ocean depths reported experiencing significant emotional distress (Epstein, Fullerton, & Ursano, 1998; Leffler & Dembert, 1998). Furthermore, fluctuations in psychological state (e.g., increases in the onset or rates of depression and anxiety) have been associated with long deployments or short dwell time between deployments (Mental Health Advisory Team IV, 2009).

Numerous studies have reported the emotional toll the prolonged duration of military combat operations during Operation Iraqi Freedom (OIF), Operation Enduring Freedom (OEF), and Operation New Dawn (OND) have had on deployed military personnel (Maguen et al., 2010; Schnurr et al., 2010; Vinokur, Pierce, Lewandowski-Romps, Hobfoll, & Galea, 2011). However, a majority of U.S. military personnel over the past 25 years have neither been unexposed to combat operations or participated in the response to a major disaster, civilian or military (Pflanz & Sonnek, 2002). Research has suggested that military occupational stressors may be less impacted by the demands and complexities of war, and may be more related to the subtle aspects of the military culture that foster stress (Pflanz & Sonnek, 2002). The occupational stressors frequently cited as contributors to psychological distress in military personnel not deployed to the warzone include changes in work hours, work responsibilities, and supervisory conflicts (Campbell & Nobel, 2009; Pflanz & Ogle, 2006; Pflanz & Sonnek, 2002). The consequences of stress in this population include productivity loss, as nearly 35% of military personnel reported leaving work early, 33% reported arriving to work late, and 32% reported working below their normal performance level as the result of stress (Bray et al., 2003).

In viewing the military as a microcosm of the larger society, various studies examining the prevalence and correlates of stress among military personnel have mirrored those in the civilian workforce. Indeed, 36% of the civilian workforce has reported experiencing stress during the workday, with 20% endorsing very high levels of stress (APA, 2011). Companies have reported annual losses of $150 billion in disability claims and lost productivity among their workforce (Cooper & Dewe, 2008; Lehmer & Bentley, 1997). Approximately 50% of workplace absenteeism, 40% of turnover, and 5% of total lost productivity has been attributed to stress (Darr & Johns, 2008; Mattenson & Ivancevich, 1987; Richardson & Rothstein, 2008). Emotionally distressed personnel in the workplace has been attributed to decreased productivity, increased workplace turnover, higher rates of absenteeism, more accidents, lower morale, and greater interpersonal conflict with colleagues, supervisors, and customers (Pflanz, 2001). Stress has been found to be more strongly associated with health complaints than financial or family difficulties (National Institute for Occupational Safety and Health, 1999). Furthermore, individuals operating in an occupational environment of low autonomy and little control appeared to suffer from higher rates of mental illness related to stress (Kim & Lee, 2009; Muntaner, Tien, Eaton, & Garrison, 1991).

In addition to the negative impact on workplace productivity, stress has been shown to contribute to the development of obesity. The positive relationship between occupational stress, obesity, and metabolic syndrome, a cluster of risk factors highly associated characterized by factors such as abdominal obesity, atherogenic dyslipidemia, high blood pressure, and insulin resistance, has been reported in various studies (Brunner et al., 2002; Chandola, Brunner, & Marmot, 2006; Marmot, Bosma, Hemingway, Brunner, & Stansfeld, 1997). Therefore, it is important to explore the relationship between stress and overall weight status.

STRESS, OVERWEIGHT, AND OBESITY: CURRENT TRENDS AND CORRELATES

Overweight and obesity are leading health concerns in the United States (Centers for Disease Control and Prevention, 2012), with estimated medical care costs totaling approximately $147 billion in 2008 (Finkelstein, Trogdon, Cohen, & Dietz, 2009). The prevalence of obesity in adults aged 20 years or older has increased in the last decades of the 20th century (Flegal, Carroll, Kit, & Ogden, 2012; Flegal, Carroll, Ogden, & Curtin, 2010; Yanovski & Yanovski, 2011). Globally, more than 1 billion adults are overweight and at least 300 million of these individuals are clinically obese (Puska, Nishida, & Porter, 2004). The Center for Disease Control (2011) characterizes overweight and obesity as ranges of weight greater than what is generally considered healthy for an individual's given height. These weight ranges are determined utilizing the body mass index (BMI, kg/m^2), a measure which generally correlates with the amount of fat on the body. Adults with a BMI between 25 kg/m^2 and 29.9 kg/m^2 and 30 kg/m^2 or higher are considered overweight and obese, respectively. In 2009-2010, the prevalence of obesity in the United States was reported as approximately 36% among adult men, 36% among adult women, and 17% among children and adolescents (Flegal et al., 2012; Ogden, Carroll, Kit, & Flegal, 2012).

Numerous research studies have reported the detrimental physiological and psychological effects of obesity. An excess in body fat has been associated with increased morbidity and early mortality, leading to approximately 280,000 excess deaths among U.S. adults annually (Flegal, Graubard, Williamson, & Gail, 2005; Reilly & Kelly, 2011; Ross & Bradshaw, 2009). Obese individuals face significant and chronic physiologic health risks including Type II diabetes, hypertension, cardiovascular disease endpoints (including coronary heart disease, stroke, and heart failure), osteoarthritis, gall bladder disease, and several forms of cancers including colon, prostate, and kidney cancer (Nelson, 2006; Roger et al., 2012; Wang et al., 2005). Reports of the psychological comorbidities in overweight and obese adolescents and adults have been as equally alarming. In the U.S., the prevalence of weight discrimination based on stereotypes that overweight and obese individuals are lazy, unmotivated, less competent, and sloppy (Puhl & Brownell, 2001, 2003; Teachman, Gapinski, Brownell, Rawlins, & Jeyaram, 2003) has increased by 66% over the past decade. These reported increases in negative attitudes towards those considered overweight or obese has translated into biases in occupational settings, healthcare facilities, and educational institutions (Andreyeva, Puhl, & Brownell, 2008). Not surprisingly, elevated depressive symptoms, body image dissatisfaction and distortion, low self-esteem, and negative global attributions towards life have been reported in overweight and obese individuals (Tuthill, Slawik, O'Rahilly, & Finer, 2006; van der Merwe, 2007).

The Armed Forces, once considered virtually impervious to the elevated overweight and obesity rates plaguing its civilian counterpart, has begun to struggle with excess body weight. According to the CDC (2010), 61% of men and 39% of women serving in the active components of the U.S. military were characterized as being overweight. A little more than 12% of active-duty personnel were described as nominally obese, an increase from the 5% of service members identified as obese in 1995. Bray and colleagues (2008) reported alarming increases of excess weight status in the U.S. military, indicating an increased need to focus on the various aspects of military life which encourage excessive weight gain.

Overweight and obese military personnel place themselves at greater risk of acute and chronic adverse health effects such as cardiovascular disease, cancer, and joint and back disorders (the leading causes of morbidity and loss of duty time in the military) (Bray et al., 2006). Military personnel who fail to maintain the minimum weight standards established by each service branch face administrative actions or discharge. In addition to the loss of manpower when service members are administratively separated for failure to meet weight standards, obesity-related illnesses and associated absenteeism costs the military more than $1 billion annually, an amount that exceeds the costs of treating tobacco- and alcohol-related illness combined (Bray et al., 2006).

The increases in obesity rates among military personnel have not been limited to those in the active duty component. The Veterans Health Administration (VA) is the largest integrated healthcare system in the U.S. and is responsible for providing medical treatment to five million patients, to include retired and medically-discharged military personnel (Das et al., 2005). Among the men and women utilizing the outpatient medical services provided at VA facilities, 66% of women and 75% of men were reported as overweight and obese, with more than 33% of women and men classified as obese (Agha, Lofgren, VanRuiswyk, & Layde, 2000).

Epidemiological literature examining the relationship between perceived stress and weight status has offered inconsistent findings. A number of studies have reported a relationship between perceived stress and excess weight status (Burdette & Hill, 2008; Roberts, Troop, Connan, Treasure, & Campbell, 2007; Smith, Baum, & Wing, 2005); others found no association between perceived stress, weight status or weight circumference (van Jaarsveld, Fidler, Steptoe, Boniface, & Wardle, 2009). A systematic meta-analytic review on the association between BMI and perceived stress revealed a positive association between the presence of adiposity and stress; however, the effects were modest and smaller than reported in previous studies (Wardle, Chida, Gibson, Whitaker, & Steptoe, 2011). Research examining the association between specific types of stress such as occupational stress has also produced divergent findings. High occupational demands, decreased job control, and increased job strain have been associated with a higher BMI (Brisson, Larocque, Moisan, Vezina, & Dagenais, 2000; Steptoe, Cropley, Griffith, & Joekes, 1999). Occupational stress has been found to be associated with increased BMI when employees reported stress-related pathophysiological changes or an inability to find enough time to exercise or prepare healthy meals (Kouvonen, Kivimaki, Cox, Cox, & Vahtera, 2005). However, studies have demonstrated no associations between body weight and occupational strain, control or demands, and two studies reported an association between high occupational stress and lower BMI (Amick et al., 1998; Overgaard, Gyntelberg, & Heitmann, 2004).

Continued efforts to definitively establish associations between stress and BMI have focused on the role of acute and chronic stress and its relationship to excess weight gain though the pathophysiological effects of the metabolic syndrome. Acute stress and abdominal adiposity have been associated with exaggerated catecholamine and glucocorticoid responses, slower cardiovascular and endocrine recovery (Gluck, Geliebter, & Lorence, 2004; Steptoe et al., 2002; Steptoe & Wardle, 2005), and exaggerated heart rate and blood pressure responses possibly driven by increased cardiac output and total peripheral resistance (Jern, Bergbrant, Bjorntorp, & Hansson, 1992; Steptoe & Wardle, 2005). Psychosocial studies examining the association between chronic stress, BMI and metabolic syndrome have reported that middle-aged women who experienced extremely stressful had an increased risk for developing metabolic syndrome; middle-aged civil servants who reported experiencing chronic occupational stress were found to have higher odds for developing the syndrome; and relationships stressors (e.g., marital dissatisfaction, divorce, and widowhood) was associated with an increased risk for developing the syndrome (Chandola et al., 2006; Raikkonen, Matthews, & Kuller, 2007; Troxel, Matthews, Gallo, & Kuller, 2005). Pathophysiologic studies have conceptualized chronic stress as the associative link to increased release of neurohormonal factors that predispose individuals to abdominal obesity and insulin resistance, key features of the syndrome (Vaccarino & Bremner, 2005). These factors include the stimulation of the HPA axis (accompanied by an increase in cortisol production), which has been shown to be associated with an accumulation of intra-abdominal adipose tissue and increased BMI (Roberts et al., 2007; Serlachius, Hamer, & Wardle, 2007). Hypercortisolemia, the prolonged exposure to inappropriately high levels of cortisol, has been frequently associated with visceral adiposity, an accumulation of fat viewed as a pathological adaptation to stress due to its sensitivity to cortisol (Alvarez, Beske, Ballard, & Davy, 2002; Goldbacher, Matthews, & Salomon, 2005; Rosmond, Dallman, & Bjorntorp, 1998). It has been reported that hypercortisolemia creates favorable conditions for increased lipoprotein lipase and hormone-sensitive lipase activity, the principle enzymes involved in the conversion of triglycerides to free fatty acids in the circulation and intracellularly, respectively (Holmes, Ekkekakis, & Eisenmann, 2010). Responsible for elevating the amount of triglycerides in adipose tissue, lipoprotein lipase, in conjunction with increased insulin resistance, exerts anti-lypolytic effects and subsequent decreased lipid mobilization, resulting in development of a hallmark of metabolic syndrome – atherogensis, the uptake of lipoproteins leading to the cellular accumulation of cholesterol and the formation of foam cells or fatty streaks (Beisiegel & St Clair, 1996; Ottosson, Vikman-Adolfsson, Enerback, Olivecrona, & Bjorntorp, 1994).

The discrepancies between studies examining the association between perceived stress and BMI may reflect differences in the design, measurement, and characteristics of the study population (Kouvonen et al., 2005). Populations in industrialized countries with lower socioeconomic status (SES) have been found to be heavier than those with more resources and access to healthier foods (Helakorpi, Patja, Prättälä, Aro, & Uutela, 2003). It has been shown that socioeconomic factors shape health-related behaviors such as eating habits and physical activity, raising the possibility that the association between perceived stress and BMI may vary according to SES because employees in lower SES groups reported higher levels of occupational stress (Santos & Barros, 2003; Siegrist & Marmot, 2004). Previous studies have found a social gradient in occupational stress and metabolic syndrome, indicating the possibility that a social gradient in metabolic syndrome and heart disease could be partially explained by greater exposure to occupational stress among less advantaged social groups; however more recent studies have reported inconsistent associations between occupational stress and components of the syndrome (Brunner et al., 1997; Marmot et al., 1991; Peter et al., 1998; Schnall, Landsbergis, & Baker, 1994; Vrijkotte, van Doornen, & de Geus, 1999). Regardless, the availability of unhealthful, energy-dense foods that promote excess weight gain are available to all SES groups in the U.S.

Stress and Food Choice

Food choice decisions are frequent in developed countries in which food is universally available and accessible, and the tyranny of choice – too many opportunities to eat – is a common experience for many in developed countries (Schwartz, 2004; Sobal, 1999). Food choice decision-making is an expected part of everyday life and most people in industrialized countries make over 200 food decisions daily (Wansink & Sobal, 2007). For example, though the number of food decisions for service members in basic training are greatly reduced and tightly controlled, these decisions expand exponentially at the completion of training due to the availability of energy dense foods and drinks on military installations and the presence of several fast food establishments located within and outside of the installations gates (Anderson, Shapiro, Lundgren, Spataro, & Frye, 2002; Smith, Klosterbuer, & Levine, 2009). Researchers have grouped the variety of factors influence food choice decisions into five categories that interact with each other and shape personal constructions of food choice decisions: (1) cultural ideals, (2) personal factors, (3) resources, (4) social factors, and (5) present contexts (Furst, Connors, Bisogni, Sobal, & Falk, 1996). Food choice has long been recognized as a process that involves psychological, social, cultural, economic, and biological forces (Reid & Hammersley, 1999; Rolls, 1999; Thayer, 1989). In particular, personal factors (e.g., sensory sensitivity to food tastes) and present contexts (e.g., perceived stress) can best explain individual responses to stress and subsequent food choice decisions.

Increased levels of perceived stress have been found to have some affect on feeding behavior (Lattimore & Maxwell, 2004; O'Connor, Jones, Conner, McMillan, & Ferguson, 2008; Wallis & Hetherington, 2009). The majority of people report alteration in their feeding behaviors during perceived periods of stress: 40% report increased caloric intake and 40% report decreased caloric intake during reported periods of perceived stress (Dallman, 2010). Prospective studies have suggested that the differences in caloric intake may be related to weight status: overweight individuals were more generally inclined to increase their caloric intake, whereas healthy and underweight individuals did not report increased caloric intake during perceived stressful periods (Block, He, Zaslavsky, Ding, & Ayanian, 2009). The shift towards selecting more palatable foods occurs independent of concerns of total caloric intake during stressful periods (Gibson, 2006; Kandiah, Yake, Jones, & Meyer, 2006; O'Connor et al., 2008). Immediate psychological states, such as stress, may promote a desire for specific foods such as the desire for coffee or chocolate prompted by mood state or hunger (Gibson & Desmond, 1999; Richardson, Rogers, & Elliman, 1996; Richardson & Rothstein, 2008). The desire to consume a particular food, or combination of foods, can later impact mood through sensory effects, associated context, cognitive expectations, psychological distraction, changes in appetite, or nutritional modulation of brain function (Gibson, 2006). Periods of intense workloads have been associated with greater energy and fat intake, or higher fat, sugar and total energy intake that could eventually lead to an energy imbalance and excess weight gain (McCann, Warnick, & Knopp, 1990; Wardle, Steptoe, Oliver, & Lipsey, 2000).

Research studies have presented conflicting results on the association between perceived stress and food choice. Studies using acute, mildly arousing stressors typically resulted an increase in food consumption, while more severe or chronic stressors resulted in reduced food intake (Wardle et al., 2000). Findings of naturalistic studies report higher energy and fat intake during stressful periods of life (McCann et al., 1990; Weidner, Kohlmann, Dotzauer, & Burns, 1996); however, others have failed to find any overall differences in intake between high- and low-stress periods or reported decreases in appetite and food intake (Popper, Smits, Meiselman, & Hirsch, 1989). Under controlled laboratory experiments, researcher have reported that acute physical or emotional distress induced increased intake of comfort foods, even when the participants were not hungry and devoid of a homeostatic need for the calories (Oliver, Wardle, & Gibson, 2000; Rutters, Nieuwenhuizen, Lemmens, Born, & Westerterp-Plantenga, 2009; Zellner et al., 2006). The conflicting data may be attributed to the inherent difficulty in obtaining valid and reliable information on food intake outside of the laboratory and individual variability in responses to stress within respondent populations (Oliver &

Wardle, 1999).

Researchers have also studied the influence of stress on specific food choices because food-induced emotions have been found to be powerful determinants of food choice (Galef, 1996; Martins & Pliner, 2005; Rozin & Schulkin, 1990). Foods eaten during times of stress typically favor high energy, low nutrient dense foods which have increased fat and/or sugar content such as sweets and chocolates, cakes and biscuits, and savory snacks (Foster et al., 2009; la Fleur, Houshyar, Roy, & Dallman, 2005; Oliver & Wardle, 1999) because these foods have been reported to evoke positive affective responses that promote ingestion (Rosenstein & Oster, 1988; Steiner, 1979; Steiner, Glaser, Hawilo, & Berridge, 2001).

CHAPTER 2: Statement of the Problem

STUDY PURPOSE AND RATIONALE

Overweight and obesity are leading health concerns in the U.S. (Singh, Kogan, & van Dyck, 2010), with the prevalence of obesity in adults aged 20 years or older has doubled between 1980 and 2002 (Flegal et al., 2012; Yanovski & Yanovski, 2011). Among military personnel, over half are either overweight or obese (CDC, 2010). Given the chronic stress associated with a military career and access to high energy, low nutrient dense foods on military bases, the purpose of this study was to examine the association between everyday stress inherent to the military, food choice, and weight status among Air Force personnel. There has been a paucity of research examining the relationships between stress, food choice decisions, and weight status in the military setting. In a first step toward filling this gap, the present investigation examined the relationships among perceived stress to food choice decisions and BMI.

AIMS AND HYPOTHESES

This study aimed to identify whether there are associations between perceived stress, BMI, and food choice decisions. A review of the literature indicated that fluctuations in perceived stress were associated with greater BMI, as well as high energy, low nutrient dense food choice decisions. Similar to the civilian population, the Armed Forces has reported experiencing an elevation in stress levels and an increase in the number of overweight and obese personnel. The relationships between perceived stress, BMI, and food choice decisions were most pronounced in individuals with greater levels of perceived stress (McCann et al., 1990; Weidner et al., 1996). Based on the data similar to the civilian population, it was hypothesized that military personnel reporting clinical levels of perceived stress will exhibit higher measures of BMI, compared to those who report sub-clinical levels of perceived stress. Further, given the susceptibility of stressed individuals to modify their food choice decisions coupled with the availability of high energy, low nutrient dense foods and drinks on military installations (Anderson et al., 2002; Smith et al., 2009), it was hypothesized that individuals who reported clinical levels of stress would make poor food choice decisions, thereby mediating the relationship between perceived stress and BMI.

SPECIFIC AIMS AND HYPOTHESES

Specific Aim One: To examine whether perceived stress is associated with greater BMI.

Hypothesis 1: Participants who reported clinical levels of stress on the Perceived Stress Scale will be more likely overweight or obese, compared to participants with sub-threshold perceived stress scores. Participants with sub-threshold perceived stress scores will report lower BMI measures.

Specific Aim Two: To assess if the proposed association between perceived stress and BMI is mediated by food choice decisions.

Hypothesis 2a: Participants who reported higher perceived stress will make poorer food choice decisions and select energy dense foods such as hamburgers, savory snacks, and sweets, compared to participants who reported lower perceived stress levels. Participants reporting lower levels of perceived stress will demonstrate better food choice decisions.

Hypothesis 2b: Participants who reported high energy, low nutrient dense food choice decisions will have higher BMI measures than participants who did not report high energy, low nutrient dense food choice decisions. Participants reporting healthy food choice decisions will exhibit unchanged or lower BMI measures.

Hypothesis 2c: Food choice will account for a significant part of the relationship between perceived stress and BMI. Participants' clinical perceived stress scores and food choice decisions will be significantly related to food choice decisions.

CHAPTER 3: Methodology

OVERVIEW

This study was a single factor, cross-sectional design. The primary independent variable was measured self-reported Perceived Stress Scale (PSS) and the mediator variable was food choice decisions. The primary dependent variable was BMI. Age, race, rank, and sex were utilized as covariates, when appropriate. All p-values are two-tailed (unless otherwise specified).

PARTICIPANTS

Study participants were Air Force military personnel stationed at Andrews Air Force Base, MD, which has a population of approximately 7,700 active-duty military personnel (Andrews AFB, 2007; Military Installation Guide, 2007). The base is charged with conducting the following missions: airlift, logistics, communication and medical support and response capabilities for senior leadership, national security components, and deploying forces (Andrews AFB, 2007). Personnel who were currently on a medical waiver that interfered with one's ability to exercise were excluded from the present study due to possible effects on BMI.

PROCEDURES

Emails briefly describing the background, methods, and importance of the study were sent to an Air Force Public Affairs Officer in order to facilitate participation among the units stationed on the base. The study information was forwarded to 11 unit commanders and permission was requested to assess personnel in their unit who were interested in participating in the study. Participants were volunteers recruited from 10 out 11 units that accepted the invitation to take part in the study. The study sample consisted of civil engineering personnel, maintenance personnel, and security forces personnel and was representative of Andrews AFB personnel in terms of Mission Support, Services, Communications, and Logistics/Readiness occupational areas (P2R2, 2007).

Participants from each unit were assessed in groups of approximately 10-30 participants. Separate assessments were scheduled for junior enlisted personnel (ranks E1-E6 who are not NCOICs) and unit leadership (ranks E7-E9, NCOICs, and officers) in order to prevent coercion. All members of the research team were introduced by their first and last names, referred to each other using their first names, and all wore civilian clothing to reduce the possibility of coercion. The purpose of the study was described and the consent form was reviewed with the participants. The survey was then only administered to those personnel who volunteered to participate and signed and returned the consent form. Survey completion took approximately twenty minutes.

MEASURES

Body mass index (BMI, kg/m²)

In accordance with procedures outlined in AFI 10-248 (U.S. Department of the Air Force, 2006), BMI was assessed by formally measuring each participant's current height and weight in inches and pounds, respectively. Height and weight was assessed when the participants removed their shoes. Height was measured using a Seca 214 stadiometer, rounded to the nearest inch (i.e., rounded down to the nearest inch if the height fraction is < ½ inch; rounded up to the nearest inch if the height fraction is ≥ ½ inch). Personnel were instructed to stand up against the wall and look directly forward, with their chin parallel to the floor. Weight was measured using a Tanita HD351 Digital Weight Scale and rounded to the nearest pound. To ensure standardization, the same height/weight equipment was used at each assessment. Once the raw height and weight data was entered into the SPSS database, an adjusted weight variable was created in which two pounds were subtracted from the raw weight in order to compensate for the uniform worn during the assessment, in accordance with AFI 10-248 (U.S. Department of the Air Force, 2006). The BMI of each participant was then calculated based on the height and adjusted weight by using the following formula:

$$\frac{\text{Weight (lb)} \times 703}{\text{Height}^2\ (\text{in}^2)}$$

QUESTIONNAIRES

Participants completed the following assessments (Appendix A):

Perceived Stress

The Perceived Stress Scale (PSS; (Cohen & Williamson, 1988) is a 10-item self-report measure of the degree to which an individual assesses life situations as stressful. It is a valid measure of global stress, and its internal reliability (alpha coefficient = .78) is slightly better than the original 14-item assessment measure (Cohen, Kamarck, & Mermelstein, 1983).

Rapid Food Screener

A rapid food screener was used to measure the overall diet quality and food choice (Block, Gillespie, Rosenbaum, & Jenson, 2000) and assess fat intake and fruit and vegetable intake in the past 12 months. The screener took approximately five minutes to complete and had been found to be comparable to the full-length Block Food Frequency Questionnaire in ranking participant fat intake ($r > .60$) and fruit and vegetable servings (Block et al., 2000). This screener was selected because it was a valid and reliable measure and did not place undo completion burden on the participant. Food selection scores for fat intake and fruit and vegetable intake were calculated using the Block algorithms prior to data analysis.

POWER ANALYSIS

The sample size for the proposed study was pre-determined because the data are archival; however, power analysis was conducted using G* Power (Faul, Erdfelder, Buchner, & Lang, 2009). Based on a multiple regression analysis with a) three variables,

b) targeted power of 80%, and c) an alpha-level of 0.05, the analysis would require a sample size of 64 per group (based on Total N = 128 based on two groups – stressed vs. non-stressed participants). Therefore, the sample size of 192 was sufficient for the current study.

Data Analysis

All data were analyzed using SPSS (v.19), a statistical software package often used for data analysis in the social sciences. A partial correlation was conducted to test the hypothesized relationships between the primary continuous variables of interest: perceive stress and BMI. Race/ethnicity, sex, age, and rank were considered covariates, when appropriate.

Mediational Analysis

Mackinnon, Fairchild, and Fritz (2008) described mediation as an evaluation of how a third variable affects the relationship between two other variables. Mediational analyses seek to identify the processes that underlie an observed relationship between predictor (X) and outcome (Y) variables via the inclusion of explanatory variables, known as a mediator variable (M). These models hypothesize that the predictor variable influences the mediator variable, which in turn influences the dependent variable. As a result, the mediator variable clarifies the nature of the relationship between predictor and outcome variables. Baron and Kenny (1986) discussed the following four steps in establishing mediation (See Figure 1):

(1) Demonstrate that the predictor variable (X) is correlated with the outcome variable (Y) to establish that there is an effect that may be mediated.

(2) Demonstrate that the predictor variable (X) is correlated with the mediator variable (M) by treating the mediator as if it were an outcome variable.

(3) Demonstrate that the mediator (M) affects the outcome variable (Y) and treat both X and M as independent variables and Y as the outcome variable in a regression equation (estimate and test path *b*). The predictor variable must be controlled in establishing the effect of the mediator on the outcome variable.

(4) Demonstrate that M completely mediates the X-Y relationship by establishing that the effect of X on Y controls for M (path *c*') is zero.

According to Baron and Kenny (1986), if all four steps were met, then the analysis was consistent with the hypothesis that the variable M completely mediated the X-Y relationship. If the first three steps were met, but Step 4 is not, then partial mediation was indicated.

Bivariate and partial correlations and hierarchical linear regression correlation analyses were conducted to test the mediational model and examine the relationships between perceived stress (X_1), BMI (Y), and specific food selections (M) listed in the study. The list of foods were grouped into the following categories as established by Tanofsky-Kraff and colleagues (2009): meats, fruits/vegetables, savory snacks, sweets, combination foods, and dairy products. Dietary data from the National Health and Nutrition Examination Survey was used to construct the food list, portion sizes, and corresponding nutrient values and daily recommended nutrient intake estimates for food on the questionnaire (G. Block, Dresser, Hartman, & Carroll, 1985; Subar et al., 2001).

Composite scores of each category were computed and the food choice responses were operationalized based on cut-off scores established by the Rapid Response Screener. For example, fruit/vegetable screener scores were dichotomized as low (<11) or not low; meat snack screener scores were dichotomized as high (+23) or not high, consistent with several national dietary recommendation guidelines (Block et al., 2000).

CHAPTER 4: Results

PARTICIPANT CHARACTERISTICS

Participant demographics are depicted in Table 1. The majority of participants were male (80.6%), enlisted (90.5%), active duty (80.2%), Caucasian (64.1%), and overweight or obese (73%). The average age for the participants was 30.9 ± 8.77 years, and average BMI was 27.5kg/m^2 ± 3.5kg/m^2, indicating that a majority of the participants were overweight (e.g., BMI between 25-29.9 kg/m^2). Military characteristics relevant to the present study are depicted in Table 3. The study sample had a greater percentage of racial/ethnic minorities (41.6% vs. 26.5%) and enlisted personnel (90.5% vs. 80.1%) as compared to the Air Force population as a whole (Air Force Personnel Center, 2012). In comparison to the Armed Forces as a whole, the sample had more women (19.4% vs. 14.3%), more racial/ethnic minorities (41.6% vs. 36%), more enlisted (90.5% vs. 83.9%, and was slightly older (mean age of 31 vs. 27 years) (DMPC, 2008). Table 3 depicts participant's health characteristics. The majority of the participants (n = 104, 54.2%) were overweight with an average BMI of 27.5 kg/m^2 (e.g., BMI between 25-29.9kg/m^2) and approximately 19% of the participants (n = 36) had a BMI in the obese range (BMI > 30kg/m^2).

Group differences: The normal weight and overweight groups differed from one another by gender. The overweight group contained more male participants (78.6%) compared to the normal weight group [21.4%; $\chi^2(1) = 13.48$, p = .000].

Data Transformations: Several data transformations were conducted in order to prepare for the MRC analyses. First, dichotomous variables were coded as 0 and 1, with the reference group coded as 0 (e.g., gender was coded as male = 0, female = 1). Second, several categorical variables that have more than two categories were converted into composite scores for the MRC analyses described below. Several variables described as "meats" were transformed into and converted into a single "meat" composite score variable. The same transformations were conducted to create composite scores of sweets, fruits/vegetables, condiments, savory snacks, and dairy variables.

Preliminary Analyses

Correlational analyses were conducted to identify factors that may be associated with the outcome variable in the current study (BMI). Factors significantly associated with the outcome variable were included as covariates in the MRC analyses to adjust for potential confounding effects. Additionally, Covariates were also entered into the analysis based on previous research on the effect of stress on food choice (Oliver & Wardle, 1999; Oliver et al., 2000).

Factors associated with BMI. Gender was negatively associated with BMI, r_s (191) = -.21, ρ = .004 (two-tailed), suggesting that men (M = 27.41, SD = 3.39) reported higher BMI measures than women (*M* = 25.59, SD = 3.54); $t(189) = 2.92$, ρ = .004). Age was also positively associated with BMI, r_s (191) = .20, ρ = .007, suggesting that older participants reported higher BMI measures than younger participants, which is also consistent with the literature to date. Ethnicity [r_s (147) = -0.12, ρ = 0.14] and rank [r_s (190) = 0.48, ρ = 0.51] were not associated with BMI. Therefore, only gender and age were included as covariates.

SPECIFIC AIMS

Specific Aim One: To examine whether perceived stress is related to greater BMI.

Hypothesis 1: Participants with higher scores on the Perceived Stress Scale will report higher BMI measures, compared to participants with lower perceived stress scores. Participants with lower perceived stress scores will report lower BMI.

Data Analysis of H1. A partial correlation analysis was used to test the hypothesis that higher perceived stress scores would be positively associated with higher BMI. Perceived stress was the predictor variable and BMI was the outcome variable. The covariates of gender and age were entered to control their effect on the predictor and outcome variables, based on previous analysis of factor associated with BMI.

Prior to the partial correlation, a perceived stress score and BMI were entered into a bivariate correlation alone to assess the association between the two variables without adjusting for gender and age as covariates. Perceived stress score was not positively related to BMI, with a coefficient of $r = 0.33$, which was not significant at $p = 0.65$. Results from the partial correlation demonstrated that perceived stress score was not significantly associated with BMI, $r = 0.10$, $p = 0.16$, after adjusting for gender and age. Therefore, the hypothesis was not supported. In accordance with Baron and Kenny's requirement for a correlation to exist between the predictor and outcome variables, the absence of a statistically significant correlation between perceived stress and BMI will make it difficult to continue the meditational analyses outlined in Specific Aim Two.

However, exploratory analyses of moderation and mediation were conducted as researchers have argued against the mandatory requirement of Baron and Kenny's Step 1 of meditational analyses (Kenny, Kashy, and Bolger, 1998; MacKinnon, Fairchild, and Fritz 2007). Inconsistent mediation can occur when a mediator acts as a suppressor variable in that the positive direct and negative indirect effects cancel each other out to yield a small and non-significant total effect of X_1 and Y; more specifically, the overall relationship between X and Y may not be significant despite the existence of a mediation (Blalock, 1969; MacKinnon, Krull, & Lockwood, 2000). Baron and Kenny (1986) provided an example of an inconsistent mediation by the relationship between stress and mood in which the mediator "coping" acted as a suppressor variable. While it would be reasonable to assume that the direct effect between mood and stress would be negative (more stress, worse mood) the researchers reported that the likely effect of stress on coping could be positive (more stress, more coping) and the effect of coping on mood as positive (more coping, better mood). As a result, the total effect of stress on mood would likely be very small because the direct and indirect effects would cancel each other out (Baron & Kenny, 1986).

Exploration of possible moderation effect. Given that there were more males than females in the sample and research has demonstrated sex differences related to the effects of perceived stress and BMI (Stroud, Tanofsky-Kraff, Wilfley, & Salovey, 2000), an exploratory analysis was conducted with the inclusion of the *Sex x Perceived Stress* interaction term in the regression analysis. The addition of the interaction term was significant, B = 0.22, β= .09, $t(189) = 2.42$, $p = .017$. An examination of cell means revealed that men ($M = 12.65$, $SD = 6.38$) reported experiencing less perceived stress than women (M = 15.51, SD = 6.92). A bivariate correlation examining the association between the predictor and outcome variables was conducted and revealed that there was a statistically significant association between perceived stress and BMI in the female sample, r = .41, p = .006, adjusting for age as a covariate However, given the limited number of women in the study sample, this finding should be interpreted with caution.

Specific Aim Two: To assess if the proposed association between perceived stress and BMI is mediated by food choice decisions.

Given that Step 1 of the meditational analysis revealed that there was not a statistically significant association between perceived stress and BMI, further analyses of the subsets of this specific aim were not conducted. An exploration of non-significant results will be examined in the discussion section of this thesis.

CHAPTER 5: Discussion

The impact of stress and the combined prevalence of overweight and obesity among military personnel have been independently documented in recent years, due to their deleterious impact on combat readiness and military operations (Pflanz & Sonnek, 2002; Stanley, 2011). Numerous studies have reported the correlations of higher levels of psychological stress with combat, deployment to a war zone, exposure to heavy casualties, fluctuations in work hours, difficulties with supervisors, and increased work responsibilities (Blood & Gauker, 1993; Campbell & Nobel, 2009; Perconte et al., 1993; Pflanz & Ogle, 2006). In regard to weight status, researchers have explored the sociodemographic predictors of overweight and obesity in military personnel and DoD research studies have surveyed the health-related behaviors among active-duty military personnel from 2002 and 2005, reporting that combined rate of overweight and obesity among the participants to be 60.5% (Smith et al., 2012). Not surprisingly, results of the current study indicated that a combined majority of the participants were overweight (54%) and obese (19%); however, there are possible explanations that could shed light on the alarming results.

One proposed reason may be the inexact nature of the BMI which generally overestimates adiposity on those with more lean body mass such as military personnel accustomed to working out regularly (Romero-Corral et al., 2008). In fact, 87% of the participants in this study met ACSM guidelines for physical activity, engaging in moderate-intensity aerobic exercise for a minimum of 30min five days-a-week or vigorous-intensity activity of aerobic exercise for a minimum of 20 minutes three days-a-week (Haskell et al., 2007). Despite the inexact nature of the BMI and physical activity of military personnel, dietary influences on base may be negatively affecting the weight status of the personnel. The increased accessibility and availability of high energy, low nutrient dense foods on and around military installations may be an alternative explanation for the large percentage of overweight and obese military personnel in this sample. In regard to stress, studies have closely examined the impact of combat stress on the quality-of-life of military personnel and their loved ones (Hoge, Terhakopian, Castro, Messer, & Engel, 2007; Jakupcak, Luterek, Hunt, Conybeare, & McFall, 2008). There has been a paucity of research explicitly examining the relationship between stress and BMI in the military population and the results of the study demonstrate a continued need to explore the etiology of overweight and obesity in military personnel beyond current practices. This was the first study that not only examined the relationship between perceived stress and BMI among military personnel but also examined the affect food choice decisions may have on the proposed relationships.

The results of this study did not indicate a positive association between perceived stress and BMI, which mirrors the results of several studies examining the relationship between perceived stress and BMI in civilian populations. It is possible physical fitness participation mandated by the Air Force or a suppressor variable may have concealed the relationship among the variables in the overall sample. However, exploratory analyses revealed that sex differences moderated the perceived stress – BMI relationship as results indicated a significant relationship between stress and BMI for females, but not males. This finding may be related to the type of foods the sexes were found to consume during periods of perceived stress. In contrast to study results examining the relationship between stress and food consumption, sex differences in the types of foods selected during periods of stress have remained consistent, as researchers have reported that men were more likely to consume savory foods and meats during periods of reported perceived stress, while women were more likely to consume sweets such as chocolate (Kandiah et al., 2006; Mikolajczyk, El Ansari, & Maxwell, 2009).

SEX, FOOD CHOICE, AND STRESS

Research examining sex differences in response to physiological and psychological stress have reported contradictory findings. The basic neuroendocrine core of stress responses does not appear to vary considerably between males and females; both sexes show sympathetic arousal in response to the perception of threat, with men demonstrating slightly stronger vascular responses and women somewhat stronger heart rate responses (Allen, Stoney, Owens, & Matthews, 1993; Matthews & Stoney, 1988).

However, a number of studies have demonstrated that glucocorticoid levels are higher in females than in males after HPA axis stimulation (Yoshimura et al., 2003) and HPA axis responses to physical exercise appeared not to differ among the sexes (Kirschbaum, Klauer, Filipp, & Hellhammer, 1995; Kirschbaum, Wust, & Hellhammer, 1992; Kraemer, Blair, Kraemer, & Castracane, 1989; Nicolson, Storms, Ponds, & Sulon, 1997). Men and women have been found not to differ in their physiological responses to acute stress and have demonstrated little variability in cortisol reactivity (Kelly, Forsyth, & Karekla, 2006; Sgoifo et al., 2003). Furthermore, adrenocorticotropic hormone and free cortisol elevations in men were twice as high as in women and the anticipation of an anticipated psychosocial stress task led to a significant free cortisol response only in men (Kirschbaum et al., 1992). Most psychological stress studies revealed no significant sex differences or higher cortisol responses in young men than in young women after exposure to acute real-life psychological stress (e.g., academic exams) or controlled laboratory stress tasks (e.g., mental arithmetic); however, other psychological studies have reported higher free cortisol stress responses in women compared to men after two social interaction challenges (e.g., social rejection) (Stroud et al., 2000). Unlike the contradictory findings reported in studies examining sex differences in response to stressful situations, research has shown distinct differences among the sexes in regard to food selection during periods of reported perceived stress.

Consistent associations between sex and specific foods have been reported in modern Western societies. Red meat, alcohol, and hearty portion sizes have been associated with masculinity, while vegetables, fruits, fish, and sour dairy products (e.g., yogurt) have been associated with femininity (Berbesque, 2009; Jensen & Holm, 1999;

Prattala et al., 2007). Studies have demonstrated that the most relevant sex differences in food choice have been the relationship between eating habits and health consciousness and eating behavior and weight control; however, important and distinct differences related to stress response has also been reported among the sexes (Arganini, Saba, Comitato, Virgili, & Turrini, 2012). Women appeared more likely to consume carbohydrate dense foods such as sweets, cookies and snacks during periods of perceived stress, while men were more likely to consume meat and fish (Kandiah et al., 2006; Mikolajczyk et al., 2009). Adolescent males and men prefer fewer low-fat foods, and consume more soft drinks than women (Beer-Borst et al., 2000; Li et al., 2000; Liebman, Cameron, Carson, Brown, & Meyer, 2001). Stressed women demonstrated a trend toward modest increases in the consumption of sweet and bland food (Grunberg & Straub, 1992). Taken together, data suggest a relationship between stress, food choice and sex. However, these potential associations have not been studied in a military population.

MILITARY IMPLICATIONS

The intended implication of this study was to examine the influence of real or perceived stress on BMI and initiate a dialogue for more specific stress and weight maintenance interventions in the military. A little more than 41% of Air Force personnel reported getting something to eat in order to cope with stress (Bray et al., 2003) and the results of the current study suggest that perceived stress might influence the eating behavior among military personnel and consequently, their weight status. The relationship between perceived stress, food choice, and BMI was moderated by sex differences, indicating differences in the response to stress between the sexes and possibly demonstrating the existence of sex-specific stressors (e.g., childrearing) that could account for the findings of this study. Research has shown that for working women stress was highest when preschool aged children were present and that for military women, stress was highest amongst those who were married with an absent (e.g., deployed, TDY-spouse, etc.) and younger enlisted (Hopkins, 2005). More broadly, more than 31% of military women reported experiencing stress simply due to being women in the military (Hopkins, 2005), requiring more study on the relationship between perceived stress, food choice, and BMI in a larger study of the military population as the current study was comprised of mostly overweight Caucasian males stationed at a single military base in Maryland. It is possible that further study in this area will help facilitate more effective weight loss and maintenance interventions targeted for each sex. Furthermore, this study highlights the need to include role of stress, its consequences, and methods in which to cope with stress in a productive manner (e.g., not using food as a means of self-soothing) in military weight loss and maintenance intervention programs.

LIMITATIONS AND FUTURE DIRECTIONS

A number of limitations need to be considered when interpreting the present results. One limitation is cross-sectional nature of the study design. Cross-sectional studies are observational studies in which the independent and dependent variables of interest are determined simultaneously for each participant (Carlson & Morrison, 2009). While an association between the two variables can be determined, cross-sectional studies generally provide little evidence demonstrating a temporal relationship between the independent and dependent variables; therefore, inhibiting the determination of causality (Carlson & Morrison, 2009). Longitudinal, prospective studies following military personnel and examining their responses to stress and subsequent changes in BMI are needed to determine the extent to which stress negatively impacts food choice selection and efforts by military personnel to maintain weight standards. Additionally, differentiating the types of stress (e.g., occupational, interpersonal) most likely to be associated with poor food choice decisions and changes in BMI may more precisely elucidate the relationships between perceived stress, food choice decisions, and BMI. Another limitation of this study is the reliance on self-report measures of the predictor variables. Studies have reported that people tended to under-report their weight, particularly among women and heavier individuals (Cash, Grant, Shovlin, & Lewis, 1992; Razavi, 2001). Also, there were temporal inconsistencies in measures evaluating perceived stress (e.g., one month) and food choice decisions (e.g., one year) which made it difficult to correlate in a more precise manner the relationships between perceived stress, food choice decisions, and BMI. The inclusion of more real-time assessments of stress levels, types of stressors, and eating behavior through the use of ecological momentary assessments would reduce the reliance on self-report measures and provide a more accurate picture of the individual's daily experiences with stress and food choice selections.

In conclusion, the study did not support an association between stress, food choice, and BMI. However, the examination of sex differences in regard to the aforementioned variables demonstrated that men were more likely to eat meats and combination foods during periods of reported perceived stress, while women were more likely to eat dairy products during stressful time periods. The results suggest that sex differences, not food choice, may have more of an influence on the relationship between perceived stress and BMI. However, given the limited number of female participants in the study sample, these results should be interpreted with caution. Additional research specifically examining the relationship between perceived stress, BMI, and food choice in female military participants is warranted.

TABLES

TABLE 1. *Participant Characteristics* (N = 192)

	n	%
Gender		
Male	154	80.6
Female	37	19.4
Race/Ethnicity		
Caucasian	111	58.4
African American	45	23.7
Hispanic	19	10
Asian	8	4.2
Other	7	3.7
Education		
Grade 12 or GED	22	11.5
Some college or technical school	129	67.2
Bachelor's degree	21	10.9
Some graduate/advanced degree	20	10.4
Marriage	59	30.9

Never Married	106	55.5
Married	26	13.6
Other		
	M (SD)	
Age	31.0 (8.9)	
BMI (kg/m^2)	27.1 (3.5)	

TABLE 2. *Participant Military Characteristics* (N = 192)

	n	%
Rank	61	32.1
Airmen (E-1 to E-4)	68	35.8
Junior Non-Commissioned Officers (E-5 to E-6)	43	22.6
Senior Non-Commissioned Officer (E-7 to E-9)	7	3.7
Company Grade Officers (O-1 to O-3)	11	5.8
Field Grade Officers (O-4 to O-6)		
Military Job/Occupation		
Communication/Intelligence	34	17.7
Administration	19	9.9
Logistics	18	9.4
Engineering/Maintenance	44	22.9
Security Forces	42	21.9
Other	35	18.2
	M (SD)	
Years of military service (TIS)	10.8 (8.2)	
Time on station (TOS)	3.6 (5.1)	
Physical Fitness Test Score	85.2 (7.2)	

TABLE 3. *Participant Health Characteristics*

		M (SD)
Lifestyle Factors		
Weekly fruit/vegetables (#)		12.73 (5.01)
Weekly meat (#)		10.05 (4.47)
Weekly sweet snacks (#)		1.86 (1.66)
Weekly savory snacks (#)		3.06 (1.78)
Weekly dairy (#)		2.92 (1.91)
Weekly combination foods (#)		1.08 (.87)
	n	%
BMI Category (kg/m2)		
Normal weight (18.5 – 24.9)	52	27.1
Overweight (25.0 – 29.9)	104	54.2
Obese (30.0 or greater)	36	18.7
Smoking Status		
Non-smoker	121	63.7
Current smoker	51	26.8
Former smoker	18	9.5
Currently dieting to lose weight	47	25
Any health conditions		
Hypertension	10	5.2
Diabetes	2	1.0
Thyroid disease	3	1.6
Other health condition	5	2.6

TABLE 4. *Correlation Analysis of Aim One*

Correlations

		Total score on PSS	Body Mass Index
Total score on PSS	Pearson Correlation	1	.033
	Sig. (2-tailed)		.650
	N	191	191
Body Mass Index	Pearson Correlation	.033	1
	Sig. (2-tailed)	.650	
	N	191	192

TABLE 5. *Exploratory Regression Analysis of Aim Two*

ANOVA[b]							
Gender	Model		Sum of Squares	df	Mean Square	F	Sig.
male	1	Regression	.904	1	.904	.078	.781[a]
		Residual	1755.550	151	11.626		
		Total	1756.455	152			
female	1	Regression	76.637	1	76.637	7.164	.011[a]
		Residual	374.391	35	10.697		
		Total	451.028	36			

a. Predictors: (Constant), Total score on PSS

b. Dependent Variable: Body Mass Index

FIGURES

FIGURE 1: Proposed meditational model examining the relationship between perceived stress, BMI, and food choice decisions in a sample of military personnel stationed at Andrews AFB.

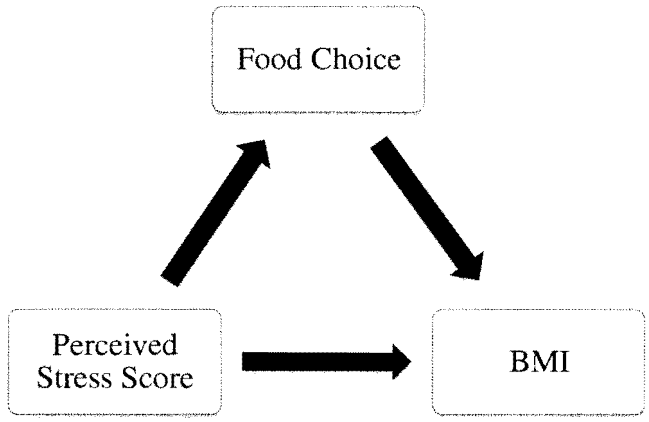
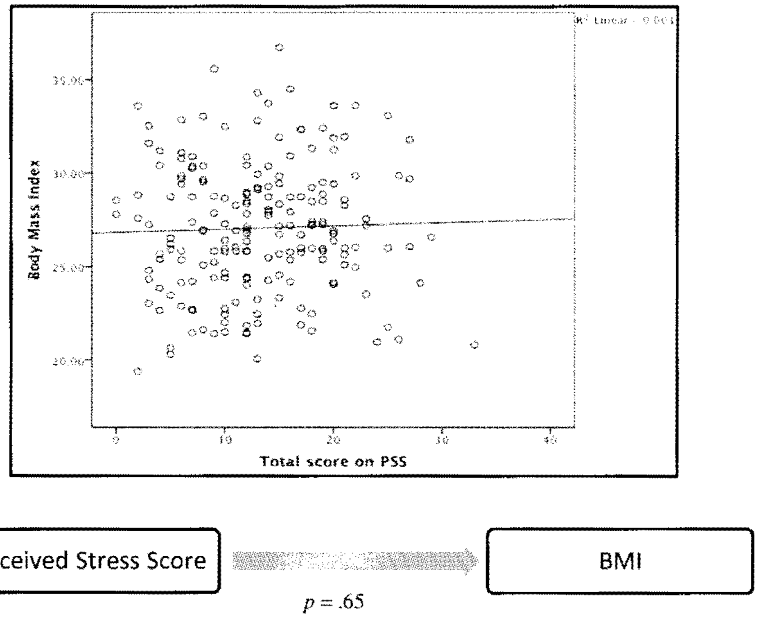


FIGURE 2: Correlation model depicting the relationship between perceived stress and BMI in a sample of military personnel stationed at Andrews AFB.



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Appendix

Participant # ___ ___ ___

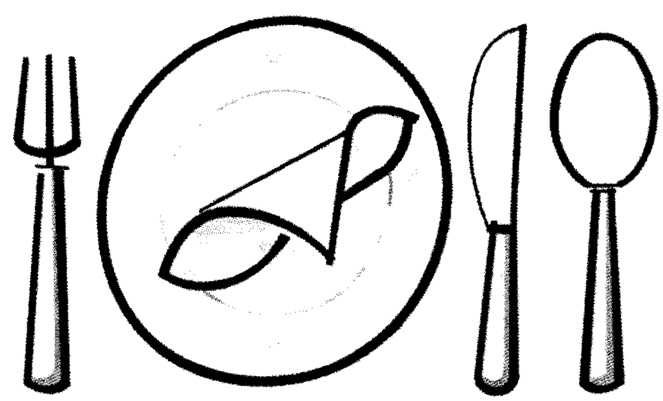
Dear Air Force Member,

The purpose of this survey is to learn about the eating habits of Air Force personnel, both in general and on base. Aside from asking about your eating habits, we will be asking you some questions about exercise and physical activity, work, lifestyle, and stress.

The survey will take approximately 20 minutes to complete. There are no right or wrong answers. If there is a question that makes you feel uncomfortable, you do not have to answer it. Your individual responses will remain confidential. An overall summary of the study results may be released to the public.

Sincerely,

Crescent A. Seibert, M.S.
Graduate Student
Department of Medical and Clinical Psychology
Uniformed Services University of the Health Sciences
Bethesda, MD 20814-4799

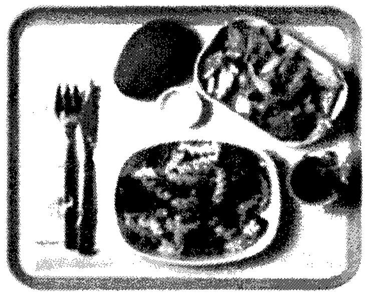


WHERE YOU GET YOUR FOOD

The next set of questions asks you about how often you have eaten food from different food outlets on base in the last 7 days.

1. How many times did you eat food from each of the following food outlets on base in the last 7 days? Include both meals and snacks. Do NOT include food brought to you from these locations from a co-worker.

___ BX Food Court
___ Base Club
___ Freedom Dining Hall (West side of base)
___ Commissary (NOT including commissary grocery shopping)
___ Church's Chicken
___ Burger King
___ Four Season's Store
___ Katmandu Kafé (in 316th HQ)
___ Hospital Cafeteria
___ Starbucks
___ Bowling Alley
___ Sports Page Café
___ Golf Course Clubhouse
___ Liberty Dining Hall (East side of base)
___ Denny's BBQ (East side of base)
___ Shoppette (East side of base)
___ Other (please specify): ____________________________



How many of the above times were snacks? _______

2. How many times did you eat food from each of the following food outlets on base in the last 7 days that was brought to you by a co-worker.

___ BX Food Court
___ Base Club
___ Freedom Dining Hall (West side of base)
___ Commissary (NOT including commissary grocery shopping)
___ Church's Chicken
___ Burger King
___ Four Season's Store
___ Katmandu Kafé (in 316th HQ)
___ Hospital Cafeteria
___ Starbucks
___ Bowling Alley
___ Sports Page Café
___ Golf Course Clubhouse
___ Liberty Dining Hall (East side of base)
___ Denny's BBQ (East side of base)
___ Shoppette (East side of base)
___ Other (please specify): ____________________________

WHAT YOU EAT

First, we are going to ask you about how often you eat various types of foods. The purpose of these questions is to give us a general idea of people's eating habits over the past year or so.

Think about your eating habits over the past year or so. About how often do you eat each of the following foods? Remember breakfast, lunch, dinner, snacks, and eating out. Mark an '**X**' in one column for each food.

Fruits and Vegetables	Less than 1/WEEK	Once a WEEK	2-3 times a WEEK	4-6 times a WEEK	Once a DAY	2+ a DAY
Fruit juice, like orange, apple grape—fresh, frozen or canned (Not sodas or other drinks)						
How often do you eat any fruit, fresh or canned (not counting juice?)						
Vegetable juice, like tomato juice, V-8, carrot						
Green salad						
Potatoes, any kind, including baked, mashed or French fried						
Vegetable soup, or stew with vegetables						
Any vegetables, including string beans, peas, corn, broccoli or any other kind						

Think about your eating habits over the past year or so. About how often do you eat each of the following foods? Remember breakfast, lunch, dinner, snacks, and eating out. Mark an '**X**' in one column for each food. (*Please note that the frequencies in each column are different from the frequencies on the previous page.)*

Meats and Snacks	1/MONTH or less	2-3 times a MONTH	1-2 times a WEEK	3-4 times a WEEK	5+ times a WEEK
Hamburgers, ground beef, meat burritos, tacos					
Beef or pork, such as steaks, roasts, ribs, or in sandwiches					
Fried chicken					
Hot dogs, or Polish or Italian sausage					
Cold cuts, lunch meats, ham (not low-fat)					
Bacon or breakfast sausage					
Salad dressings (not low-fat)					
Margarine, butter or mayo on bread or potatoes					
Margarine, butter or oil in cooking					
Eggs (not Egg Beaters or just egg whites)					
Pizza					
Cheese, cheese spread (not low-fat)					
Whole milk					
French fries, fried potatoes					
Corn chips, potato chips, popcorn, crackers					
Doughnuts, pastries, cake, cookies (not low fat)					
Ice cream (not sherbet or non-fat)					

3. How often did you use an automobile to get food from base food outlets in the last 7 days? (If you did not eat food from any base food outlets in the past week, leave this question blank.)

___ Never
___ A few times
___ Sometimes
___ Most of the time
___ All of the time

4. How many times did the season, weather, or temperature prevent you from going somewhere to get food on base in the last 7 days? ____times

5. How many times did you purchase food or beverages (not including water) in vending machines in your flight or building in the last 7 days? _____times

6. How many times did you eat food or snacks that were available in your flight or building in the last 7 days (e.g., flight snack shack, food brought in by your co-workers)? _____times

7. How many times did you bring your own meal(s) from home to work in the last 7 days? ____times

8. How many times did you bring your own snack(s) from home to work in the last 7 days? ____ times

BASE FOOD OUTLETS

The next few questions ask you to rate different aspects of food outlets on base.

9. In general, how **close** are the food outlets on base to where you work? Circle the appropriate number.

1	2	3	4	5	6
Very Close to where I work					Very far from where I work

10. In general, how **convenient** is it to obtain food from food outlets on base? Circle the appropriate number.

1	2	3	4	5	6
Very Convenient					Not Convenient

11. In general, how **affordable** is it to eat at food outlets on base? Circle the appropriate number.

1	2	3	4	5	6
Cheap					Expensive

12. In general, how would you rate the overall **nutritional value** of food from food outlets on base? Circle the appropriate number.

1	2	3	4	5	6
Not healthy					Very healthy

13. In general, how would you rate the overall **taste** of food from food outlets on base? Circle the appropriate number.

1	2	3	4	5	6
Not Tasty					Very Tasty

14. Now rate how important each of the following factors are to you personally when choosing where to get your food on base on a typical work day. Circle the appropriate number.

Importance of closeness to workplace:

1	2	3	4
Not at all Important	A little Important	Moderately Important	Very Important

Importance of convenience (little time and effort):

1	2	3	4
Not at all Important	A little Important	Moderately Important	Very Important

Importance of low cost:

1	2	3	4
Not at all Important	A little Important	Moderately Important	Very Important

Importance of nutritional value:

1	2	3	4
Not at all Important	A little Important	Moderately Important	Very Important

Importance of good taste:

1	2	3	4
Not at all Important	A little Important	Moderately Important	Very Important

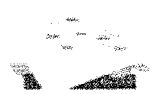
Importance of eating where my co-workers/friends eat:

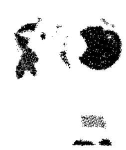
1	2	3	4
Not at all Important	A little Important	Moderately Important	Very Important

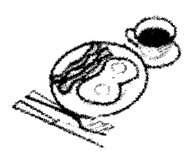
Importance of closeness to where I run my errands on base (e.g., drycleaners, shopping, gas, bank):

1	2	3	4
Not at all Important	A little Important	Moderately Important	Very Important

OFF BASE AND HOME EATING







The next five questions ask you about how many times you have eaten food from locations off base in the last 7 days.

15. How many times did you eat food from fast food restaurants off base during work hours in the last 7 days? _____times

16. How many times did you eat food from "sit down" restaurants off base during work hours in the last 7 days? _____times

17. How many times did you eat food from fast food restaurants off base outside of work hours in the last 7 days? _____times

18. How many times did you eat food from "sit down" restaurants off base outside of work hours in the last 7 days? ______times

19. How many times did you eat food from home outside of work hours in the last 7 days? _____times

PHYSICAL ACTIVITY

We are interested in finding out about the kinds of physical activities people do as part of their everyday lives. The following questions will ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?
   _____ **days per week**

   ☐ No vigorous physical activities → ***Skip to question 3***

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?
   _____ **hours per day**

   _____ **minutes per day**

   ☐ Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

   _____ **days per week**

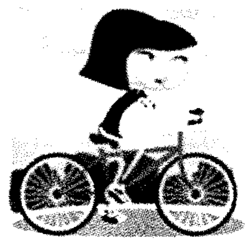
   ☐ No moderate physical activities → ***Skip to question 5***

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

   _____ **hours per day**

   _____ **minutes per day**

   ☐ Don't know/Not sure



Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

   _____ **days per week**

   ☐ No walking → ***Skip to question 7***

6. How much time did you usually spend **walking** on one of those days?

   _____ **hours per day**

   _____ **minutes per day**

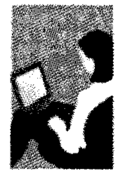
   ☐ Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

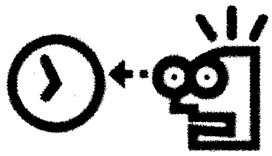
7. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____ **hours per day**

_____ **minutes per day**



☐ Don't know/Not sure

STRESS 

Now we are going to switch gears and ask you some questions about stress. This next set of questions asks you about your feelings and thoughts during the last month. In each case, please indicate with a check how often you felt or thought a certain way.

1. In the last month, how often have you been upset because of something that happened unexpectedly?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

2. In the last month, how often have you felt that you were unable to control the important things in your life?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

3. In the last month, how often have you felt nervous and "stressed"?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

4. In the last month, how often have you felt confident about your ability to handle your personal problems?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

5. In the last month, how often have you felt that things were going your way?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

6. In the last month, how often have you found that you could not cope with all the things that you had to do?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

7. In the last month, how often have you been able to control irritations in your life?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

8. In the last month, how often have you felt that you were on top of things?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

9. In the last month, how often have you been angered because of things that were outside of your control?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

WORK

Now we are going to ask you about different aspects of your work and job.

1. In the past 7 days, how many days did you work on base? ________ days

2. In the past 7 days, how many hours did you work on base? ______hours

3. In the past 7 days, how many nightshifts did you work on base? ______nightshifts

4. On average, how many minutes does it take for you to get to work (i.e., time you leave your house to time you get to your building)?_______ minutes

5. On average, how many minutes does it take for you to get home from work (i.e., time you leave your building to time you get home)?_______minutes

6. What is your duty status?

___ Active duty
___ National Guard
___ Reserve

7. If you are in the Guard or Reserve, how long have you been working full-time at Andrews AFB? (Active duty leave this question blank.)
____Years, ____Months, ____Weeks

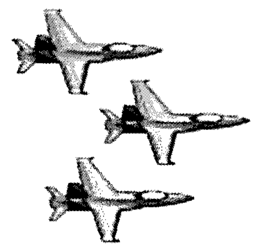
8. What is your military rank?

Enlisted	Officer
___ E-1 AB	___ O-1 2d Lt
___ E-2 Amn	___ O-2 1st Lt
___ E-3 A1C	___ O-3 Capt
___ E-4 SrA	___ O-4 Maj
___ E-5 SSgt	___ O-5 Lt Col
___ E-6 TSgt	___ O-6 Col
___ E-7 MSgt	___ O-7 Brig Gen
___ E-8 SMSgt	___ O-8 Maj Gen
___ E-9 CMSgt	___ O-9 Lt Gen

9. Which building do you work in on base?

___ 316th Headquarters (Bldg 3755)
___ 89th Headquarters (Bldg 1419)
___ Hospital (Bldg 1050)
___ Communications (Bldg 1558)
___ Air Refueling Wing (Bldg 3755)
___ Civil Engineering (Bldg 3465)
___ Airlift (Bldg 3252)
___ Supply (Bldg 3066)
___ CA Readiness (Bldg 2495)
___ Small Arms Range (Bldg 2350)
___ Kennel
___ Other (please specify): ________________

10. What is your Military Job/Occupation?
___ Administration
___ Communications/Intelligence
___ Logistics
___ Medical
___ Engineering/Maintenance
___ Operations
___ Security Forces
___ Supply and Service
___ Scientific/Professional
___ Support
___ Pilot
___ Other (please specify):_______________



11. What is your Air Force Specialty Code (AFSC)?____________

12. How many years of military service do you have? ____ years

13. How long have you been stationed at Andrews AFB? _____year(s) _____month(s)

14. Approximately how much time have you spent deployed, TDY, and on leave since you have been stationed at Andrews AFB?
____ Years, ____ Months, ____ Weeks, _____ Days

15. What is the approximate date of your last physical readiness test?
Month:___Year:_____

16. What was your score on your last physical readiness test? _____

17. What is the approximate date of your next physical readiness test?
Month:___ Year: _____

18. Which of the following statements best describes how your weight has changed since you have been stationed at Andrews AFB:
___ I have gained weight → How many pounds have you gained? ____pounds
___ I have lost weight → How many pounds have you lost? ___pounds
___ My weight has stayed the same.

HEALTH, LIFESTYLE, AND DEMOGRAPHICS

This last set of questions asks you about your health, lifestyle, and demographic information.

1. Are you currently dieting in order to lose weight? ___Yes ___No

2. Do you currently smoke or use smokeless tobacco products (e.g., chewing tobacco)?
   ___ Yes ___ No

   If yes, how many cigarettes do you smoke per day on average? ____ cigarettes
   If yes, how much smokeless tobacco did you use per day on average? ________

3. Are you a former smoker?
   ___ Yes ___ No

   If yes, when did you last smoke regularly? Month: ____ Year:______
   If yes, how many cigarettes did you smoke per day on average? ____ cigarettes
   If yes, how much smokeless tobacco did you use per day on average? ________

4. Have you been diagnosed with any of the following health conditions? Check all that apply.
   ___ Hypertension
   ___ Diabetes
   ___ Thyroid Disease
   ___ Other (please specify): ______________________________

5. Do you have any dietary restrictions? Check all that apply.
   ___ Food allergies
   ___ Vegetarian
   ___ Religious
   ___ Other

6. Gender:
   __ Male
   __ Female

7. Age: _____

8. Ethnicity:
   ___ Hispanic or Latino
   ___ Not Hispanic or Latino

9. Race (check all that apply):
- ___ American Indian or Alaska Native
- ___ Asian
- ___ Black or African American
- ___ Native Hawaiian or Pacific Islander
- ___ White
- ___ Some other race (please specify): ______________

10. What is the highest level of education or year of school you have completed?
- ___ Less than 12 years of school
- ___ Grade 12 or GED (High School Graduate)
- ___ Some college or technical school
- ___ Bachelor's degree
- ___ Some graduate or professional training
- ___ Advanced degree (graduate or professional school)

11. What is your current marital status?
- ___ Never married
- ___ Married
- ___ Widowed
- ___ Divorced
- ___ Separated

12. Where do you currently live?
- ___ Dormitory
- ___ Base housing – West Side of Base
- ___ Base housing – East Side of Base
- ___ Off base

END OF SURVEY.

THANK YOU FOR TAKING THE TIME TO COMPLETE THIS SURVEY.