AN EXPLORATION OF BIOPSYCHOSOCIAL AND MARITAL HEALTH IN MILITARY COUPLES USING HEART RATE VARIABILITY

by

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April, 2013

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In the United States there are approximately 3.6 million military personnel, over half of which are married. Few researchers have focused on the biological, psychological, and social health of military couples despite the significant presence of military couples in the U.S., and the unique experiences and stressors that military couples are faced with compared to civilian couples. One way to capture the experience of military couples is to use heart rate variability (HRV), a physiological assessment that measures an individual's stress response and relaxation. Heart rate variability captures the amount of distress experienced by an individual because it is a physiological response to biological, psychological, and social stress. The present study focuses on the experience of male military personnel and their female spouses. This project includes literature and analysis of biological factors (BMI, blood pressure, and medical diagnoses), psychological factors (emotional problems, posttraumatic stress symptoms, and level of global distress), social factors (family and practical problems), marital adjustment, and HRV from each partner in the military couple dyad. The significant contribution of this study is the exploration of the individual biopsychosocial health of "his" (military personnel) and "her" (spouse) relationship using assessment of physiological stress through the inclusion of heart rate variability. This research provides information and analyses on the types of biopsychosocial stressors affecting military couples and how the nature of biopsychosocial health in military

couples affects military marriages. Implications from this research provide data and recommendations to help health professionals and researchers better understand and serve military couples.

AN EXPLORATION OF BIOPSYCHOSOCIAL AND MARITAL HEALTH IN MILITARY COUPLES USING HEART RATE VARIABILITY

A Thesis

Presented to the Faculty of the Department of Child Development and Family Relations

East Carolina University

In Partial Fulfillment of the Requirements for the Degree

Master of Science in Marriage and Family Therapy

by

Amelia R. Muse, M.S.

April 2013

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ACKNOWLEDGEMENTS

First, I would like to thank the men and women that serve in the United States military, and their families and friends, for their sacrifices and dedication. I would like to thank Sergeant Nathan Gould for his love and support during his deployment to Kuwait and Afghanistan during the first year of my master's program and throughout the process of writing this thesis.

To my chair, advisor, supervisor, and mentor, Dr. Angela Lamson, thank you for your time, dedication, support, and encouragement, which allowed me to accomplish more than I thought myself capable of. You fostered my personal and professional growth, and as a result I feel more confident in seeing my life goals to fruition. I would also like to express my gratitude to my committee members. Thank you to Dr. Andrada Ivanescu for giving me your time and expertise, and challenging me to think critically. I would like to thank Dr. Mark White for his consistent and calm mentorship, and always trying to answer my questions when I was not even sure what I was asking (and always helping me in the end). To Dr. Carmen Russoniello, thank you for helping me expand my knowledge and develop a passion for biofeedback research, something I will take with me throughout my career.

I would also like to thank the medical providers and staff at Seymour Johnson Air Force Base for graciously allowing the ECU research team to work alongside them for the duration of this project.

Finally, I would like to thank Peter and Fran Muse, Lisa Buchner, Meghan Lacks, Rola Aamar, Sara Herrity, DeAnna Coughlin, Grace Wilson, Chrissy Beavers, and Rachel Chiu for their consistent love, support, and care throughout this process.

This research was conducted by East Carolina University and is made possible by a cooperative agreement that was awarded and administered by the U.S. Army Medical Research

& Materiel Command (USAMRMC) and the Telemedicine & Advanced Technology Research Center (TATRC), at Fort Detrick, MD, under Contract Number: W81XWH1120221. The views, opinions and/or findings contained in this thesis are those of the author(s)/East Carolina University and do not necessarily reflect the views of the Department of Defense and should not be construed as an official DoD/Army position, policy or decision unless so designated by other documentation.

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PREFACE

My decision to pursue a thesis on the biopsychosocial health of military couples was influenced by my own experience in being a member of a military couple. During the first year of my master's program, my significant other was deployed to Kuwait and Afghanistan for 12 months. I knew that I would be stressed beyond imagination throughout his deployment, and I was right. When I decided that I wanted to pursue a thesis, I was hesitant to join a project on military couples, but I also knew that it could be a productive way to explore and validate my own experience.

With the guidance and support of Dr. Angela Lamson and my committee, I was able to pursue a project that I was truly passionate about: the biopsychosocial experience of military couples. I am awed at the amount of growth I have experienced in my writing skills and ability to think critically and analytically. Additionally, I did not expect to develop a passion for the value of biofeedback, and particularly SDNN, a variable I focus on in my thesis. The skills I have gained during this process will be the foundation for my future career in research. This project has inspired me to pursue a career in researching biofeedback and the biopsychosocial experience of couples and families. It is my hope that this research will contribute to understanding and providing support for military personnel and their spouses and families.

CHAPTER ONE: INTRODUCTION

In the United States there are approximately 3.6 million military personnel (including Reservists, National Guard, and civilians who are contracted for work) (Department of Defense [DOD], 2010) and in the past decade (2002- 2012), there have been the longest sustained ground combat operations since the Vietnam War (Seal, Bertethal, Miner, Sen, & Marmar, 2007). Military personnel casualties of the Vietnam War totaled 58,220 (National Archives and Records Administration, n.d.) and Operation Enduring Freedom, Operation Iraqi Freedom, and Operation New Dawn military personnel casualties (wounded or dead) total 57,240 as of March 27, 2013 (DOD, 2013). Military personnel have experienced more multiple deployments, traumatic injuries, and combat exposure during Operation Iraqi Freedom and Operation Enduring Freedom wartime than any time in the past and have resulted in more wounded warriors who have survived after injury (Gawande, 2004; Hoge et al., 2008; United States Army Surgeon General, 2005).

It is no surprise that military personnel typically face more life threatening injuries during their occupational duties than civilians (Hourani, Williams, & Kress, 2006), which has then led to chronic pain and life-long disabilities. Chronic stress has been another challenge associated with military duties and life (Hourani et al., 2006). Unfortunately, this stress can have a secondary effect and transfer onto relationships, thus influencing a personnel's spouse along with their marital satisfaction, quality, and adjustment (Lewis, Lamson, & White, 2012).

Of the 1.4 million active duty military personnel, 55.8% are married (DOD, 2010). In the US, military personnel are likely to marry earlier than civilians (Hogan & Seifert, 2010; Lundquist, 2007). Civilians typically marry (on average) at 29 for men and 27 for women (U.S. Census Bureau, 2011). In the military, half of all active duty personnel are married, and of those

who are married, half are under the age of 25 (Hogan & Seifert, 2010). In a study by Lundquist (2007) with a sample of 650 military personnel ages 23-27, the average age at marriage was 20 years old. Additionally, when compared to their civilian counterparts, military personnel who married early were also more likely to get a divorce (Hogan & Seifert, 2010). Despite the significant presence of military couples in the U.S., and the unique experiences and stressors that military couples are faced with compared to civilian couples, few researchers have focused on the biological, psychological, and social health of military couples (Lewis et al., 2012).

The biopsychosocial model, introduced by George Engel in 1977, described the systemic complexity of health and functioning of individuals. To fully understand individuals, their life experiences, and the factors that contribute to the development of diseases and conditions, the behavioral, psychological, social, and cultural factors must be considered in addition to the biological factors that are traditionally the main focus in health and medicine (Engel, 1977). The biopsychosocial model serves as the premise for the conceptual model of this study and is explained in more detail in the following chapter. Engel's model is used to conceptualize how the biopsychosocial components of the individual and marital health of the couple are related to the physiological presence of stress of the individual as measured by heart rate variability. Heart rate variability captures the amount of distress experienced by an individual because it is a physiological response to biological, psychological, and social stress (Boysen, Lewin, Hecker, Leichter, & Uhlemann, 2007; Tan, Dao, Farmer, Sutherland, & Gevirtz, 2011; Thayer, Åhs, Fredrikson, Sollers, & Wager, 2012; Smith et al., 2011)

In the present study, which focuses on male military personnel and their female spouses, the biopsychosocial model is used to understand the relationship between the biological, psychological, and social factors experienced by "him" (the military personnel) and "her" (the

civilian spouse) that are associated with each partner's heart rate variability and marital adjustment. This model seems appropriate given that military personnel face physical challenges from deployment (biological factor), demands of a military occupation (biological, psychological, and social factors), and threat of injury (biological and psychological factors). In addition, depression and posttraumatic stress disorder are two examples of prevalent mental health diagnoses (psychological factor) experienced after returning from deployment (Hoge et al., 2008). Depression and PTSD (both psychological factors) have been shown to affect physical and social functioning and also have an impact on military spouses (Hoge et al., 2008; Mansfield et al., 2010). Furthermore, depression (Mansfield et al., 2010), anxiety (Mansfield et al., 2010), and posttraumatic stress (Lewis et al., 2012; Seal et al., 2007) have been experienced not only by military personnel but also by their spouses.

More specifically, the physical health and emotional stress conditions experienced by military personnel and their spouses have been associated with challenges to personal and relational functioning (Mansfield et al., 2010; Solomon et al., 2012). Spouses of military personnel who have been deployed have experienced a higher incidence of depressive, sleep, anxiety, and adjustment disorders and acute stress reactions compared to spouses of military personnel who have not been deployed (Mansfield et al., 2010). The stressors that are a part of military life (e.g., deployment, unpredictable work commitments) have been associated with these diagnoses and have resulted in dissolution of military marriages (Hogan & Seifert, 2010; Mansfield et al., 2010). It is estimated that military personnel are 27% more likely to divorce compared to civilians, based on comparisons between military and civilian samples, however military personnel are reportedly 21% more likely (than civilians) to marry between 23-27 years of age (Lundquist, 2007).

Given the complexity of biopsychosocial health and the lack of research on military couples with the couple as the unit of analysis, this thesis focuses on how heart rate variability (HRV) is associated with biopsychosocial markers and distress factors of each member of the dyad. Heart rate variability is a physiological assessment of the status of the autonomic nervous system and measures the levels of stress response and relaxation for an individual (Thayer et al., 2012). This thesis includes literature and analysis on biological factors (BMI, blood pressure, and medical diagnoses), psychological factors (mental diagnoses, emotional problems, presence of post-traumatic stress symptoms, and level of distress), social factors (family and practical problems), marital adjustment, and HRV from each partner in the couple dyad. The significant contribution of this study is through the exploration of the individual biopsychosocial health of "his" (military personnel) and "her" (spouse) relationship with particular attention given to the assessment of physiological stress through the inclusion of heart rate variability. The hypotheses for this thesis are as follows:

1. Participants will be divided into four groups based on quartiles of the standard deviation of normal-to-normal (SDNN) (a component of HRV that will be described more completely in the next chapter) whereby the upper quartile reflects low physiological distress and the lower quartile reflects high physiological distress. Heart rate variability, measured as SDNN will be associated with biological, psychological, and social markers:
    a. The SDNN of couples in which the husband and wife are both in the lower quartile of SDNN will have higher BMI, blood pressure, and frequency of medical conditions than couples in which the husband and wife are in the upper quartile of SDNN.

b. The SDNN of couples in which the husband and wife are both in the lower quartile of SDNN will have a higher frequency of emotional problems, PTSD symptoms, and general distress than couples in which the husband and wife are in the upper quartile of SDNN.

c. The SDNN of couples in which the husband and wife are both in the lower quartile of SDNN will have a higher frequency of family problems and practical problems than couples in which the husband and wife are in the upper quartile of SDNN.

2. Couples in the bottom quartile of SDNN will have low scores on the Marital Adjustment Test, and couples in the upper quartile of SDNN will have high scores on the Marital Adjustment Test. Couples in which the husband and wife are in different quartiles will have lower scores on the Marital Adjustment Test compared to couples in the same quartiles.

3. SDNN will moderate the relationship between biopsychosocial markers and marital adjustment:

a. SDNN will strengthen the relationship between biopsychosocial markers and marital adjustment for couples in which the husband and wife are in the lower quartile of SDNN.

b. SDNN will strengthen the relationship between biopsychosocial markers and marital adjustment for couples in which the husband and wife are in the upper quartile of SDNN.

c. SDNN will weaken the relationship between biopsychosocial markers and marital adjustment for couples in which the husband and wife are in different quartiles of SDNN.
d. SDNN will weaken the relationship between biopsychosocial markers and marital adjustment for couples in which the husband and wife are in the same quartiles of SDNN.

The following chapters include a literature review on the biopsychosocial health of military couples along with the methodology and results from research focused on the biopsychosocial health of military couples from an Air Force base. The implications from this research provide data and recommendations to help medical and behavioral health clinicians and researchers better understand and work with military couples. This research also provides information and analyses on the types of biopsychosocial stressors affecting military couples and how the reciprocal nature of biopsychosocial health in military couples affects military marriages.

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CHAPTER TWO: LITERATURE REVIEW

There are 1.4 million active duty military personnel and 2.7 million spouses and children of active duty military personnel (Department of Defense [DOD], 2010). Of all of the members in the military who are active duty, 37.9% are Army, 22.7% are Air Force, 22.4% are Navy, 14% are Marine Corps, and 3% are Coast Guard (DOD, 2010). No matter the branch, military personnel experience unique life stressors in comparison to most civilians, such as multiple deployments (Seal, Bertenthal, Miner, Sen, & Marmar, 2007), combat injuries (Seal et al., 2007), separation from family (Chawla, & Solinas-Saunders, 2011); as well as an array of mental and physical health conditions including posttraumatic stress disorder (PTSD; Hoge, Castro, Messer, McGurk, Cotting, & Koffman, 2008), sleep challenges (Germain et al., 2012), chronic pain (Macey, Morasco, Duckart, & Dobscha, 2011; Otis, Gregor, Hardway, Morrison, Scioli, & Sanderson, 2010), and hypertension (Granado et al., 2009).

Military spouses also experience mental and physical health conditions related to stressors from military life, such as obesity (Almond, Kahwati, Kinsinger, & Porterfield, 2008) anxiety (Mansfield, Kaufman, Marshall, Gaynes, Morrisey, & Engel, 2010), depression (Mansfield et al., 2010), and sleep disturbances (Mansfield et al., 2010). Spouses of military personnel who have been deployed by and large have met criteria for more psychological diagnoses than spouses of military personnel who have not been deployed (Mansfield et al., 2010). Overall, military personnel and spouses experience significant mental and physical health conditions related to military lifestyle stressors and consequently must learn to navigate their health and marriage in the context of a world of unexpected events and life altering experiences.

To date, there has been little research conducted on the relationship between common stressors (e.g., marital stress, psychological problems, physical problems) and health conditions

of military couples (Lewis, Lamson, & White, 2012). What is known is that military couples typically marry earlier and divorce at a higher rate than civilian couples (Hogan & Seifert, 2010) and commonly experience more areas of conflict (e.g., substance abuse, domestic violence, emotional expression, time spent at work) compared to civilian couples (Griffen & Morgan, 1988). In the midst of so many things that can happen in the life of military personnel, researchers must go beyond the use of military personnel in a sample, to simultaneously include the spouses of the personnel, especially since there is research to suggest that marital partners influence one another's overall health (Lewis, 2012).

The most systemic way to capture experiences of military couples is to use a biopsychosocial model; a conceptualization of the biological, psychological, and social factors that all contribute to health and functioning. The biopsychosocial model maintains that there is an interaction between biological, psychological, and social factors that influence an individual's functioning (Engel, 1977). Biological experiences can contribute to social and psychological experiences, and vice versa.

The biopsychosocial model grounds the conceptual model described below and is used to show the relationship between the biopsychosocial and marital health for military personnel and their spouses with consideration for heart rate variability. The biopsychosocial health of each partner in a military couple is represented (via Figure 1) as well as inclusion of heart rate variability of each partner, which moderates the relationship between the biopsychosocial health of each partner and marital adjustment.

The purpose of this literature review is to present the research pertaining to the biopsychosocial health of military personnel, their spouses, as well as research conducted with couples (as the unit of analysis) in relation to the assessment of physiological distress through

heart rate variability. This literature review fills a gap by exploring the unique biological, psychological, and social factors affecting military personnel and their spouses, in order to better understand the complexity of how individual stressors from military life affect marital adjustment.

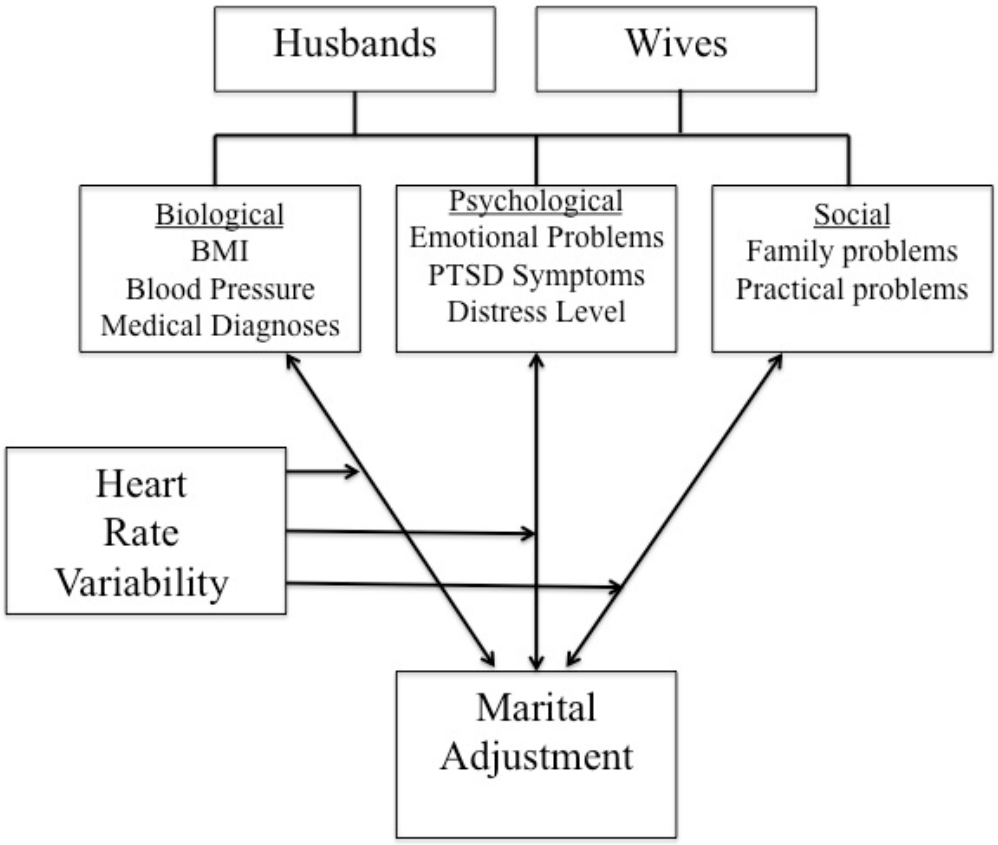

Figure 1. Conceptual model: Biopsychosocial health factors and the relationship to heart rate variability and marital adjustment.

Heart Rate Variability

With the significant presence of biological, psychological, social, and relational stressors experienced by military personnel and spouses (discussed in the following sections), it is

important to assess for the physiological presence of stress in military couples. A biomarker, such as heart rate variability (HRV) can be used to measure the physiological presence of distress (Tan, Dao, Farmer, Sutherland, & Gevirtz, 2011; Thayer, Åhs, Fredrikson, Sollers III, & Wager, 2012). HRV measures the variability in units of time between consecutive heartbeats and can show the status of the autonomic nervous system in terms of sympathetic ("fight or flight") and parasympathetic ("rest and digest") activity (Thayer et al., 2012). SDNN, which is regarded as the most common and straightforward measure of HRV (Hassett et al., 2007; Lehrer et al., 2004; Tan et al., 2009; Umetani, Singer, McCraty, & Atkinson, 1998), is the standard deviation of normal-to-normal QRS intervals (see Appendix B) whereby high SDNN reflects low physiological distress and low SDNN reflects high physiological distress. Sympathetic activity, which can be triggered by exercise, stress, or cardiovascular conditions, increases the heart rate, increases blood pressure, activates sweat glands, inhibits gastrointestinal activity, and results in a low frequency range of HRV (0.04-0.15 Hz) (Acharya, Joseph, Kannathal, Lim, & Suri, 2006) and a low SDNN (Tan et al., 2009). Parasympathetic activity, which can be triggered by functioning of internal organs (such as during digestion), trauma, or allergic reactions, decreases the heart rate and results in a high frequency range of HRV (0.15-0.4 Hz) (Acharya et al., 2006) and a high SDNN (Tan et al., 2009). Thus, high frequency HRV represents parasympathetic activity (relaxation) and low frequency HRV represents sympathetic activity (stress) (Thayer et al, 2012).

HRV is cited in several studies with samples from the general population, including biological, psychological and social measures. For example, HRV is documented as a measure along with health assessments for patients with cardiovascular disease (Acharya et al., 2006; Thayer & Lane, 2007) and diabetes (Boysen, Lewin, Hecker, Leichter, & Uhlemann, 2007).

Other researchers use HRV for assessment and interventions targeting PTSD (Tan et al., 2011, discussed below), depression (Licht et al., 2008), and marital satisfaction (Smith et al., 2011, discussed below).

Heart rate variability has also been used in research with military personnel, particularly in France and with veterans in the United States (Jouanin, Dussault, Peres, Satabin, Pierard, & Guezennec, 2004; Tan et al., 2011). Tan et al. (2011) used HRV to demonstrate the presence of physiological stress in veterans with PTSD as well as measure changes before and after a treatment intervention for PTSD. These researchers also found that veterans with PTSD demonstrated more sympathetic activity as measured by HRV compared to veterans without PTSD, and that using HRV biofeedback was an effective way to reduce symptoms of PTSD (Tan et al., 2011). Beyond research on HRV with personnel, research also exists using HRV with couples in relation to marital satisfaction (Smith et al., 2011). Although use of HRV with military couples is limited, research with veterans and civilian couples suggests that HRV is a valid indicator of physiological distress that can be altered by relational issues (Smith et al., 2011) or PTSD symptoms in veterans (Tan et al., 2011). Using a biomarker such as HRV can contribute to the understanding of the physiological presence of distress in military couples and with an increase in deployments and combat missions since 2001, any research that furthers the health of military personnel and couples is a significant addition to the literature.

Heart rate variability is an ideal way to capture the distress experienced by military personnel and their spouses because the stress response of the autonomic nervous system, detected by HRV assessment, can be a response to several types of stressors such as the biological, psychological, or social stressors experienced by military couples. For the purpose of this thesis (to be described later), HRV is analyzed using SDNN, a variable from HRV

assessment that is most often used in HRV research (Hassett et al., 2007; Lehrer et al., 2004; Tan et al., 2009; Umetani, Singer, McCraty, & Atkinson, 1998). Since HRV is sensitive to the biopsychosocial stressors experienced by military couples, it is used as a moderating variable in this study to determine whether it strengthens the relationship between biopsychosocial stressors and marital adjustment.

Biological Health

Military personnel experience a plethora of physical conditions and a continuum of mild to debilitating injuries. According to the Department of Defense (DOD), 45,583 individuals were medically evacuated through air transport during Operation Iraqi Freedom (OIF) and 9,099 individuals were medically evacuated through air transport during Operation Enduring Freedom (OEF) between March 19, 2003 and February 28, 2009 (Fischer, 2009). Of the 54,682 medical evacuations during OIF and OEF, 43,745 cases were non-hostile-related transports, and the remaining 10,907 cases were of hostile-related wounded service members with injuries (Fischer, 2009). From September 2001 to January 2009 there were 1,184 amputations from conflicts during OIF and OEF, with an additional estimated 102 amputations occurring from conflicts unaffiliated with the U.S. wars in the Middle East (Fischer, 2009).

Unfortunately some injuries are not as easily identified and manifest or progress over months of time, such as traumatic brain injury (TBI). From 2003 to 2007, the Military Health System recorded 43,779 TBI diagnoses (Fischer, 2009). The overall prevalence of injuries sustained during OEF and OIF has been significant and these physical injuries and conditions have ultimately influenced psychological and relational health, lifestyle, and overall adjustment for military couples when personnel return home.

Besides physical injuries, there are several health conditions that are of concern for military personnel. For example, those who are exposed to combat have an increased risk for hypertension (Granado et al., 2009). Additionally, researchers found that military personnel who deployed and experienced multiple stressful combat exposures were more likely to exhibit hypertension than those who did not experience multiple stressful combat exposures (Granado et al., 2009).

Obesity is another condition that is a health concern for military personnel (Almond et al., 2008). In a 2002 study on the prevalence of obesity in active duty military personnel, 53% of active duty men and 29% of active duty women had BMIs that indicated that they were overweight and 4% of active duty men and 9% of active duty women had BMIs that indicated that they were obese (Kress, Peterson, & Hartzell, 2006). Although the rates of obesity in the military do not significantly differ from rates of obesity among the general U.S. population (Almond et al., 2008), male veterans with PTSD have been shown to have higher BMI and increased risk for obesity compared to the general population with 76.5% of male military veterans in the U.S. reportedly overweight or obese (Almond et al., 2008), compared to 64.5% of adults in the general population of the U.S. reportedly overweight or obese (Flegal, Carroll, Ogden, & Johnson, 2002).

Military spouses also appear to have a similar rate of obesity to the U.S. general population (Cole and Horacek, 2009). These researchers reported a mean BMI of 32 and a 65% obesity occurrence in a sample of 91 military spouses. Of the health concerns reported among the cohort of 91 military spouses, 30% of the health concerns were related to diabetes, hypertension, and high cholesterol (Cole & Horacek, 2009). Although the rate of obesity and the most common health concerns among military spouses seem to have a similar prevalence to

those in the general U.S. general population (Cole & Horacek, 2009), obesity rates typically coincide with other reported health conditions and may be exacerbated by the frequent mobility and systemic stressors that are more common in military families. These concerns should not go unnoticed within military families or the military healthcare system.

Health conditions, such as those most common among military personnel and spouses, must be assessed and considered within a larger health perspective, including the reciprocal influence between biological and psychological health. Military couples, as previously discussed, are experiencing high rates of physical symptoms and conditions, but biological factors do not entirely capture the health and functioning of military marriages. Thus, it is important to also consider the psychological and social components of health for military personnel and their spouses.

Psychological Health

Military personnel.

Stress, related to deployment and injuries is associated with the development of several psychological symptoms in military personnel such as PTSD (Fischer, 2009), depression (Hoge et al., 2008), anxiety (Hoge et al., 2008), and substance abuse (Hoge et al., 2008). From 2003 to 2007, the Military Health System recorded 39,365 diagnoses of PTSD among "American Forces" (Fischer, 2009). PTSD is an intense emotional response following a traumatic experience and is characterized by re-living the traumatic experience, avoidance of aspects related to the traumatic event, emotional numbing, and hyper-arousal (American Psychiatric Association, 2000). Combat exposure has been associated with the development of PTSD in soldiers; soldiers who had traumatic experiences during combat, such as knowing personnel killed in combat or exposure to dead bodies, were more likely to report PTSD symptoms (Hoge

et al., 2008). Approximately 17% of military personnel who have deployed to Iraq or Afghanistan experience PTSD (Hoge et al., 2008) compared to an estimated lifetime prevalence in the United States of 8-9% (Johnson, Maxwell, & Galea, 2009).

As PTSD has become more prevalent in the military population compared to the civilian population in recent years (Fischer, 2009; Johnson, Maxwell, & Galea, 2009), suicide rates have also been higher in the military population compared to the civilian population (Black, Gallaway, Bell, & Elspeth, 2011). Black et al. examined Army suicide rates from 2001-2009 in a sample of soldiers and compared the Army rates to the rates of a civilian population. From 2007-2009 there were higher rates of Army personnel committing suicide when compared to civilian populations (Black et al., 2011). Among active duty military personnel, suicide is the second leading cause of death (Center for Disease Control and Prevention [CDC], 2007), accounting for approximately one-fifth of deaths among active duty Air Force (ADAF) members (Yamane & Butler, 2009). From 1990 to 2004, there were 642 suicide cases among ADAF personnel (Yamane & Butler, 2009).

Depression, anxiety, and substance abuse were found to be prevalent in Air Force suicide cases (Conner, McCarthy, Bajorska, Caine, Tu, & Knox, 2012). In an Air Force cohort of 309,861 personnel tracked from 2003-2009, there were 227 suicide cases (Conner et al., 2012). Mood disorders were associated with 29.1% of the suicide cases, anxiety disorders were associated with 18.5% of the suicide cases, and substance use disorders were associated with 9.7% of the suicide cases (Conner et al., 2012). Among Army suicide cases, mood, anxiety, personality-related disorders, and substance use disorders were associated with suicide (Black et al., 2011).

Of Army suicides from 2001-2009, 90% of the individuals had high stress loads, defined as the total number of risk factors (Black et al., 2011). Fifty-four percent of the suicide cases did not have a reported mental health diagnosis, 46% of the suicide cases did receive a previous mental health diagnosis, and 31% of the suicide cases had received more than one previous mental health diagnosis (Black et al., 2011). In a 2002 Department of Defense Survey of Health Related Behaviors among Military Personnel conducted with 12, 756 active duty military personnel, almost 28% of respondents met criteria indicating a need for a mental health evaluation, but only 12.5% of respondents had received mental health treatment in the past year (Hourani et al., 2006).

Seventy-nine percent of Army suicide cases showed evidence of the presence of personal problems including relationship problems, military or work related stress, or physical health issues (Black et al., 2011). Forty percent of the suicide cases had evidence of five or more stressors (e.g., legal problems, relationship problems, physical health problems), with 90% of all cases having at least one stressor (Black et al., 2011). As the number of stress factors increased, there was an increase in the overall stress-load, which was associated with suicide (Black et al., 2011). In the military, stress load appears to increase rapidly without time to cope with or adjust for changes (Black et al., 2011).

Depression symptoms, a risk factor for suicide, have been shown to increase following deployment (Hoge et al., 2008). In a sample of Army and Marine personnel, 11.4% met criteria for depression before deploying to Afghanistan and 15% met criteria for depression post-deployment (Warner et al., 2007). The number of deployments, along with psychological risk factors (mental health history including history of suicide attempts), was associated with suicide event characteristics (such as substance use, history of self-injury, etc.) among Army suicides

(Black et al., 2011). Suicide rates were higher for Army military personnel who were male, with deployment experience, and/or with a history of mental health diagnoses and treatment (Black et al., 2011). However, depression among military personnel is not only associated with deployment; approximately one-third of entry-level military personnel reported some depressive symptoms, and approximately 15% of male entry-level military personnel and 22% of female entry-level military personnel in basic training met criteria for moderate to severe major depressive disorder, which are higher rates than found in the general population (Warner et al., 2007).

Military spouses.

Stress from deployment has also been associated with depression and anxiety in military spouses (Mansfield et al., 2010). Spouses of military personnel who have been deployed have had more mental health diagnoses than spouses of military personnel who have not been deployed (Mansfield et al., 2010). Military spouses also experience distress from the military lifestyle, especially during separation due to deployment. Mansfield et al. (2010) examined the electronic medical records of 250,626 wives of active-duty Army soldiers. The deployment of a spouse and the length of the deployment were associated with diagnoses of depressive disorders, sleep disorders, anxiety, acute stress reaction, and adjustment disorders (Mansfield et al., 2010). Wives whose husbands were deployed for 1 to 11 months had more diagnoses than wives whose husbands were not deployed (Mansfield et al., 2010). Wives whose husbands were deployed for more than 11 months had more mental health diagnoses than wives whose husbands were not deployed or were deployed for less than 11 months (Mansfield et al., 2010). Unfortunately, as evidenced in this segment, there is very little research on the overall psychological health of military spouses.

The influence of stress on military personnel and their spouses.

The unique experiences and stressors of military personnel and their spouses, such as combat exposure and separation due to deployment, can also impact psychological health (Hourani et al., 2006; Mansfield et al., 2010), which can quickly twist and turn into physiological outcomes. Chronic stress, defined as a sustained "lack of control or uncertainty" (Heuser & Lammers, 2003, p. S71), is destructive in duration and magnitude, and has been consistently linked with immune deregulation and susceptibility for impairment or infection (Graham, Christian, & Kiecolt-Glaser, 2006). The magnitude of stress can result in such significant psychological changes that ultimately the stress can influence an individual's susceptibility to disease (Gorman & Sloan, 2000). Mental health conditions are thus more likely in the presence of psychological stress, especially chronic stress, when an individual believes that environmental demands placed on him or her exceed his or her capacity (Gorman & Sloan, 2000). Military life, stress, deployment, injuries, and physical conditions clearly contribute to the biological and psychological functioning of military personnel and their spouses, but can also impact relational health and thus the marriage.

Social and Relational Health

Military personnel and their spouses are affected by stress and health conditions, unique to the military lifestyle, that are associated with negative social and relational functioning (Mansfield et al., 2010; Solomon et al., 2012). Certain experiences that are common among military personnel, such as combat exposure, can lead to symptoms of PTSD, and affect the functioning of the family, the military personnel, and the marriage (Dirkzwager, Bramsen, Adèr, & Van der Ploeg, 2005; Galovski & Lyons, 2004; Hourani et al., 2006).

The family.

Military personnel report more family stress than civilian workers (Hourani et al., 2006). High levels of familial stress for military personnel are related to risk for mental health problems (Hourani et al., 2006), and among a sample of military personnel who met criteria for a mental health evaluation, 38.2% reported high levels of family stress (Hourani et al., 2006). There is evidence that trauma symptoms transmit from male military personnel to their female spouses (Dirkzwager et al., 2005) as well as from male military personnel to their children (Gibbs, Martin, Küpper, & Johnson, 2007; Rentz et al., 2007); an incredible concern in the context of relational health. Additionally, posttraumatic stress may interfere with effective parenting and a parent's ability to connect with his or her child (Galovski & Lyons, 2004), demonstrating that distress experienced by military personnel has a systemic impact on the whole family.

Military personnel.

Military personnel also report higher levels of occupational stress than civilian workers, which has also been associated with risk for mental health problems (Hourani et al., 2006). Sixty percent of military personnel reported high levels of occupational stress in a survey of over 12,000 military personnel (Hourani et al., 2006). Additionally, social, practical, and relational problems (race/ethnicity, marital status, lack of social support, military rank, component status, legal problems, and interpersonal relationship problems,) were associated with Army suicide event characteristics (Black et al., 2011). All of these significant stressors have the capacity to influence marital adjustment.

Male military personnel who exhibited symptoms of PTSD or sustained Traumatic Brain Injuries (TBIs) were more likely to have poor marital adjustment (less satisfaction in their marital relationship and more disagreements with their spouse) following the TBI or trauma

precipitating the onset of PTSD (Claude Blais, & Boisvert, 2005; Dekel, Enoch, & Solomon, 2008). Military personnel who experience war trauma tend to report low relationship satisfaction and their spouses also tend to report low relationship satisfaction (Goff, Crow, Reisbig, & Hamilton, 2005). For military personnel who experienced a combat stress reaction, Solomon et al. (2012) found that their marital relationships had more expressed conflict and anger and also less intimacy in comparison to military personnel who did not endure combat stress. In addition, consensus about role divisions, social relations, open expression of feelings, and overall commitment was compromised in relationships whereby military partners suffered combat stress (Solomon et al., 2012). These findings indicate that there is a risk for both members of military couples to experience relational distress (Goff et al., 2005; Griffen & Morgan, 1988), especially for military personnel who have experienced a combat stress reaction, or "battle shock," a response to participation in combat that can involve impaired emotional or relational functioning due to anxiety or social withdrawal (Solomon, Mikulincer, & Kotler, 1987; Solomon et al., 2012).

The marital relationship.

In a study comparing areas of conflict for military and civilian couples, military couples appear to have similar conflicts as civilian couples, but there are a few areas whereby military couples show a greater risk when compared to their civilian counterparts (Griffen & Morgan, 1988). For example, military couples tend to have a greater vulnerability to alcohol abuse (Burt & Biegel, 1980; Griffen & Morgan, 1988; Williams, 1984) and relational risk factors, including a higher risk of physical abuse toward the wife (Griffen & Morgan, 1988) when compared to civilian couples. There are also social risk factors related to military husbands when compared to civilian husbands. Military husbands tend to have a higher risk for lack of emotional

expression (Griffen & Morgan, 1988; Keith & Whitaker, 1984) and increased occupational demands (from the military) (Frances & Gale, 1973; Orthner & Bowen, 1982; Patterson & McCubbin, 1984) compared to civilian husbands (Griffen & Morgan, 1988). Although military couples have been shown to encounter unique challenges in their relationship (Burt & Biegel, 1980; Griffen & Morgan, 1988; Williams, 1984), resilience of individuals within military couples has been shown to protect and enhance marital adjustment (conflict resolution, relationship satisfaction, and cohesion) when faced with challenges such as posttraumatic stress (Melvin, Gross, Hayat, Jennings, & Campbell, 2012).

The social and relational health of couples is important because the marital relationship is closely associated with healthy functioning (Graham, Christian, & Kiecolt-Glaser, 2006). The relationship between marital health and individual health has been supported in the literature with civilian couples (Gottman & Notarius, 2000; Kiecolt-Glaser & Newton, 2001). Specifically, maritally satisfied couples have a lower risk for health concerns than couples with low marital satisfaction (Gottman & Notarius, 2000) and couples who are satisfied with their marriage also have better general health than couples who are not satisfied (Kiecolt-Glaser & Newton, 2001). Marital satisfaction differs from marital adjustment, which encompasses couples' conflict resolution, relationship satisfaction, and cohesion, but there is a lack of research on the relationship between couples health and their marital adjustment. It is expected that similar trends between marital satisfaction and health exist in military couples, however the lack of research on the health and satisfaction of military couples leaves many questions unanswered. With the unique stressors that military couples face, it is important to consider the potential for biological, psychological, and social factors that can affect military personnel and their spouses,

and underscores the value of the biopsychosocial model (Engel, 1977) when researching military couples.

Summary

Since military couples experience a disproportionate amount of health conditions and stress related to military lifestyle (Black et al., 2011; Hourani et al., 2006; Mansfield et al., 2010), measuring health conditions and distress would provide valuable information about the experience of military couples as a dyad, address gaps in the literature about military couples, and determine the healthcare needs of military couples from a biopsychosocial perspective.

The goal of the current study was to examine the biopsychosocial distress of military personnel and their spouse and explore the relationship between the couples' biopsychosocial health and their physiological distress. The literature has shown that military couples experience high levels of stress and experience complicated health conditions as a result of a military lifestyle, deployment, deployment separation, or a military occupation. Existing literature on military couples has explored the biological, psychological, and social health as independent health factors. The model used in this study provides a unique perspective by bringing together biological variables, psychological variables, and social variables of the couple dyad and exploring couples' health using heart rate variability. This study provides insight about how biopsychosocial factors affect military personnel individually and within their marriage so that military healthcare providers are able to better understand and care for military couples.

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CHAPTER THREE: METHOD

This thesis is part of a larger study on integrated care with military couples. The purpose of the larger study is to gather information about the unique trends in military couples' physical, psychological, social, and relational health. Data were collected from patients and their spouses on a base at a military health care center using self-report measures, partner report measures, and biomarkers such as blood pressure, body mass index (BMI), and heart rate variability. Couples recruited to participate in the study provided information about their physical, psychosocial, and relational health during a series of visits. The larger study has followed military couple participants for approximately one year. The present study (garnered from the larger study) focused on individual distress and marital adjustment for military couples based on assessments from Time 1 of the larger study. This study used measures that provided information on the biopsychosocial functioning of military couples who attended an appointment at a health care center located on a military base.

Sample

Participants were married couples recruited from a military health care center on base in the southeastern US. Participants were recruited through IRB approved recruitment measures at the medical center. One of the IRB approved researchers on base asked each visiting patient (after entering their exam room) if he or she was married. If the patient stated that he or she was married, the researcher asked if he or she would be interested in participating in the study. Upon agreement to participate, the participant scheduled the next appointment at the medical center and brought his or her spouse or if the personnel and spouse were both at the initial visit, they were able to participate at that time, if both consented. Inclusion criteria for this thesis was that the couple was married and had one partner who was active duty, neither person had a serious

mental health condition (i.e., severe clinical depression, suicidal ideation assessed by the PHQ-9, severe PTSD assessed using the PTSD Checklist, serious cognitive delays) and the couple was not currently receiving marital therapy services.

All couples who participated in the study reviewed the informed consent with a researcher. Couples completed physical, psychosocial, and relational health assessments as part of the research as well as had their blood pressure, height, weight, and heart rate variability measured. If military personnel or a spouse demonstrated that they needed further mental health care at any point during the research assessment or based on results (particularly related to the depression or post traumatic stress), then they were given several reputable referrals to an appropriate mental health service. If a spouse was deployed during participation, the couple was not able to participate during the deployment given that both partners must be present in accordance with the research protocol.

Context

This study took place at a military primary health care clinic in the southeastern United States that is located on an Air Force base. The clinic serves members of the U.S. military, including veterans and military personnel from the Army, but the majority of patients are enlisted in the Air Force. The facility is comprised of several units and is staffed by some civilian workers, but primarily by military personnel. There are typically six to eight medical providers and 12-16 medical assistants on site. Each medical provider typically sees a maximum of 30 patients per day; with approximately 15 minutes spent with each patient. Recruitment for this study took place in the family medicine unit of the health care clinic. The research team screened patients for marital status and entered the patients' rooms if the patient was married in order to further explain the project and invite the patient and his or her spouse to participate.

Recruitment of participants occurred in the waiting time in the exam room before the medical provider began the appointment in order to not interrupt the procedures and work of the medical providers and medical assistants.

Measures

For the purpose of this thesis, physiological (HRV), biological (physical markers, medical diagnoses), psychological (mental health diagnoses, Distress Thermometer [emotional subscale], social (Distress Thermometer [social subscale]), and relational (Marital Adjustment Test) factors were collected from each partner of a marital dyad (See Appendix A-C).

Physiological Marker

Heart rate variability (HRV), was used in this study to assess the physiological presence of distress, and reflected a unique aspect of the participant's physical health. HRV measures the variation of time between consecutive heartbeats and can show the status of the autonomic nervous system. Sympathetic activity decreases the inter-heartbeat interval and parasympathetic activity increases the inter-heartbeat interval (Thayer, Åhs, Fredrikson, Sollers III, & Wager, 2012). High frequency HRV represents parasympathetic activity (relaxation) and low frequency HRV represents sympathetic activity (stress) (Thayer et al, 2012).

A software program, *HRV Live!*, recorded participants' HRV. The researcher placed a wireless infrared (IR) pulse sensor on the fingertip of each participant. The IR pulse sensor is a pulse wave measurement method based on photoplethysmograph (PPG) (Biocom Technologies, 2008). The PPG method emits IR light, and absorption or reflection of IR light signals changes in the volume of blood flow (Shelly & Shelley, 2001). The quantity of light absorbed or reflected identifies a pulse wave (Shelly & Shelley, 2001). The sensor was connected to the *HRV Live!* software through a Bluetooth connection (Biocom Technologies, 2008). The sensor

and software collected raw pulse and HRV data by repetitively measuring RR intervals of heartbeats (Appendix D) (Biocom Technologies, 2008). Then, the software analyzed and filtered (cleaned noise from the assessment using a formula) the participants' 12 minute recording of HRV to produce a report on two five-minute time intervals of the HRV assessment (Biocom Technologies, 2008).

This project uses SDNN as a measure of HRV. SDNN, the standard deviation of normal-to-normal QRS heartbeat intervals (whereby high SDNN reflects low physiological distress and low SDNN reflects high physiological distress), is the standard HRV variable that is used most often in HRV research (Hassett et al., 2007; Lehrer et al., 2004; Tan et al., 2009; Umetani, Singer, McCraty, & Atkinson, 1998). HRV has been used in research with military personnel in France and veterans in the U.S. (Jouanin, Dussault, Peres, Satabin, Pierard, & Guezennec, 2004; Tan, Dao, Farmer, Sutherland, & Gevirtz, 2011) and most recently with military couples as the unit of analysis (Lewis, Lamson, White, Russoniello, Ivanescu, 2012).

Biomarkers

Biomarkers for this study included blood pressure, height, weight, and body mass index (BMI). The height, weight, and blood pressure of the participants were measured and BMI was calculated using the height and weight measurements. To capture biological health conditions, participants were asked to self-report their current health conditions. Health conditions were measured by a question in the demographic section of the assessment packet that asked, "Please list all of your current medical health diagnoses."

Psychosocial Markers

The PTSD Checklist (PCL) was used to assess posttraumatic stress symptoms. Two versions of the PTSD Checklist were used; the PCL-M for military personnel and the PCL-C for

civilians. Both versions consist of 17 questions with a 5-point Likert scale, with one indicating "not at all" and five indicating "extremely." The Distress Thermometer is another measure that was used in the study, which captures biological, psychological, and social functioning via self-report. It was originally developed to assess distress of cancer patients from five stress domains: practical, family, emotional, physical, and spiritual (Mitchell, 2010). The Distress Thermometer includes a 10-point Likert scale to assess global distress, with zero indicating "no distress" and ten indicating "extreme distress." The Distress Thermometer includes a "problem list" that is a table of 37 areas that relate to the five stress domains. Participants are asked to check yes or no next to each distress factor if the factor had been a cause of distress in the past week. This thesis focused on the "emotional problems" subscale and the "social problems" subscale (comprised of the family and practical problems questions).

For detecting distress, the Distress Thermometer has a sensitivity (i.e., ability to detect the presence of distress) of 78.3%, and a specificity (i.e., ability to identify the absence of distress) of 66.5% (Mitchell, 2010). Mitchell (2010) found that the Distress Thermometer could detect the presence of distress in 78.3% of people who completed the assessment who were experiencing distress (sensitivity), and it could detect the absence of distress in 66.5% of people who completed the assessment who were not experiencing distress (specificity). It has been found to have a reliability coefficient of .80 in a sample of cancer patients (Tang, Zhang, Pang, Zhang, & Song, 2011). Of the publications that have cited research using the Distress Thermometer, (Mitchell, 2010) none have documented the use of the measure with military populations. However, more research on the Distress Thermometer has been published recently (Artherholt & Fann, 2011; Ford & Mann, 2012), giving credibility to its usefulness in better understanding biopsychosocial health.

Relational Markers

To capture the relational health of couples, the Locke-Wallace Marital Adjustment Test (MAT) was used. The MAT, which measures marital relationship adjustment, has been used widely since its development in 1959 (Freeston & Pléchaty, 1997). The MAT assesses relationship adjustment, agreement and disagreement on issues (e.g., finances), and relationship style. The MAT has high internal reliability and adequate internal consistency (Freeston & Pléchaty, 1997). The MAT has been used in research with veterans and their spouses (Sherman, Sautter, Jackson, Lyons, & Han, 2006), making it an important marital assessment for this study. The administration of the MAT in the Sherman et al. study is similar to the present study's administration; each partner filled out separate questionnaires and was not able to see one another's responses (2006). Sherman et al. did not report a coefficient of reliability for use of the MAT with their veterans and spouses sample (2006), however the MAT has been found to have a reliability of α=.90 among a sample of 236 marriages (Locke & Wallace, 1959).

Procedure

For the purpose of the current study, data collection occurred during one visit with the military personnel and his spouse at the medical facility. Data collection occurred in a private room in the medical clinic with the researcher and the couple. Upon arrival of the couple, the researcher reviewed and discussed the informed consent packet that participants signed if they agreed to participate. Physical markers (height, weight, blood pressure) were measured separately for each partner by the researcher during the research appointment with the couple. Next, one spouse completed the pen and paper questionnaire and assessments while the other spouse completed a 12 minute HRV assessment administered by the researcher using a finger sensor and *HRV Live!* software. The finger sensor detected and recorded participants' heart rate

variability for 12 minutes and the software provided a report of participants' heart rate variability, including SDNN. While in the data collection room, the participants were separated by large desk with a tall room divider so that participants did not see their spouse while they were completing the paper and pen questionnaire or the HRV assessment. After each spouse finished their task, they switched so that each spouse completed the HRV measurement and the pen and paper questionnaire and assessments. If mental health assessments indicated that participants needed additional mental health care (researchers set predetermined cutoff scores for the depression and posttraumatic stress assessments) researchers provided two mental health referrals and discontinued the couple from participation in the study.

Analysis

Participants were sorted into quartiles, separated by wives and husbands, based on the distribution of SDNN. SDNN is a measure of HRV that is used most often in HRV research, and it is regarded as the most "straightforward" measure of HRV (Hassett et al., 2007; Lehrer et al., 2004; Tan et al., 2009; Umetani, Singer, McCraty, & Atkinson, 1998). SDNN analysis using quartiles is commonly used in HRV research (Christensen, Schmidt, Mølenberg, & Toft, 2005; de Bruyne et al., 1999; Liao, Carnethon, Evans, Cascio, & Heiss, 2002) including research with military and veteran populations (Aslani, Aslani, Kheirkhah, & Sobhani, 2011; Bilchick et al., 2002). Several studies have utilized the lowest quartile of SDNN as a basis for comparison (Aslani et al., 2011; Christensen et al., 2005; Bilchick et al., 2002; de Bruyne et al., 1999; Liao et al., 2002).

SDNN, the independent variable of interest, is dichotomized by the lower quartile (lowest 25% of SDNN) versus the higher quartile (highest 25% of SDNN). Comparisons between SDNN lower and upper quartile groups were made using the Mann-Whitney U test as

appropriate for the non-normal distribution of SDNN. The Mann-Whitney U test is appropriate for small samples and ordinal variables (Nachar, 2008). The Mann-Whitney U test determines if the variable of one group is "stochastically" larger than another group, expressed as (Nachar, 2008):

$$H_0: \theta_x = \theta_y$$

$$H_1: \theta_x > \theta_y$$

For hypothesis one, the Mann-Whitney U test was used to determine if participants in the lower quartile of the SDNN distribution had higher BMI, blood pressure, frequency of medical conditions, frequency of emotional problems, PTSD symptoms, general distress, and frequency of family problems and practical problems than participants in the upper quartile of the SDNN distribution. For hypothesis two, the Mann-Whitney U test was used to determine if couples in the lower quartile of SDNN had lower Marital Adjustment Test scores than couples in the upper quartile of SDNN. For the second part of hypothesis two, the Mann-Whitney U test was used to determine if couples with partners in different quartiles have lower scores on the MAT compared to couples with both partners in the same quartile. For hypothesis three, multiple regression analyses were used to determine if SDNN was a significant moderator for the relationship between the biopsychosocial markers (BMI, blood pressure, frequency of medical conditions, frequency of emotional problems, PTSD symptoms, general distress, and frequency of family problems and practical problems) and marital adjustment for couples in the same quartile, and a non-significant moderator for couples in different quartiles. An example of a moderator effect in the context of the military population (from previous research) is the finding that the association between PTSD and verbal and physical aggression was stronger in the presence of many

depressive symptoms, meaning that depressive symptoms had a moderating effect on the relationship between PTSD and aggression (O'Donnell, Cook, Thompson, Riley, & Neria, 2006).

Summary

The goal of this study was to examine individual stress in military couples in the form of biological, psychological, and social stress as related to physiological stress and marital adjustment. This study provided insight about how stress affects military personnel and their spouses and demonstrated a model to holistically treat military couples facing stress in an integrative care environment.

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CHAPTER FOUR: AN EXPLORATION OF BIOPSYCHOSOCIAL AND MARITAL HEALTH IN MILITARY COUPLES USING HEART RATE VARIABILITY

During Operation Iraqi Freedom and Operation Enduring Freedom military personnel have experienced more multiple deployments, traumatic injuries, and combat exposure than any time in the past (Gawande, 2004; Hoge et al., 2008; United States Army Surgeon General, 2005). The demands and risks associated with military life can lead to stress, and unfortunately, this stress can have a secondary effect and transfer onto relationships, thus influencing a personnel's spouse along with their marital satisfaction, quality, and adjustment (Lewis, Lamson, & White, 2012). Of the 1.4 million active duty military personnel, 55.8% are married (DOD, 2010), and of those who are married, half are under the age of 25 (Hogan & Seifert, 2010).

Despite the significant presence of military couples in the U.S., and the unique experiences and stressors that military couples are faced with compared to civilian couples, few researchers have focused on the biological, psychological, and social health of military couples (Lewis, Lamson, White, Russoniello, & Ivanescu, 2012). In the present study, which focuses on male military personnel and their female spouses, the biopsychosocial model (Engel, 1977) is used to understand the relationship between the biological, psychological, and social factors experienced by "him" (the military personnel) and "her" (the civilian spouse) that are associated with each partner's heart rate variability and marital adjustment. This model seems appropriate given that military personnel face threats to their physical welfare, risks to psychological health, and a plethora of issues that can challenge social well-being. The purpose of this article is to examine the biopsychosocial distress of military personnel and their spouse and explore the relationship between couples' biopsychosocial health and their physiological distress.

Literature Review

Biopsychosocial Model

The biopsychosocial model, introduced by George Engel in 1977, described the systemic complexity of health and functioning of individuals. To fully understand individuals, their life experiences, and the factors that contribute to the development of diseases and conditions, the behavioral, psychological, social, and cultural factors must be considered in addition to the biological factors that are traditionally the main focus in health and medicine (Engel, 1977). The biopsychosocial model, used in the present study, suggests that there is an interaction between these factors that influence an individual's functioning (Engel, 1977). Engel's model is used as a framework to conceptualize how the biopsychosocial components of the individual and marital health of the couple are related to their physiological presence of stress as measured by heart rate variability. Heart rate variability captures the amount of distress experienced by an individual by measuring a physiological response to biological, psychological, and social stress (Boysen, Lewin, Hecker, Leichter, & Uhlemann, 2007; Tan, Dao, Farmer, Sutherland, & Gevirtz, 2011; Thayer, Åhs, Fredrikson, Sollers III, & Wager, 2012; Smith et al., 2011).

Biological Health of Military Couples

Casualties among military personnel total 56,433 for Operation Enduring Freedom, Operation Iraqi Freedom, and Operation New Dawn as of September 18, 2012 (DOD, 2012). In addition to complex physical injuries (e.g., joint or muscle damage, amputations), there are several other chronic health conditions that are of concern. For example, those who are exposed to combat have an increased risk for hypertension (Granado et al., 2009); those who deployed and experienced multiple stressful combat exposures were more likely to exhibit hypertension than those who did not experience multiple stressful combat exposures (Granado et al., 2009).

Obesity is another condition that is a health concern for military personnel (Almond, Kahwati, Kinsinger, & Porterfield, 2008). In a 2002 study on the prevalence of obesity in active duty military personnel, 53% of active duty men and 29% of active duty women had a Body Mass Index (BMIs) that indicated that they were overweight, and 4% of active duty men and 9% of active duty women had BMIs that indicated that they were obese (Kress, Peterson, & Hartzell, 2006).

Military spouses also experience challenges to their physical health; during deployment of their husbands, military spouses report changes in body weight (Blount, Curry, & Lubin, 1992; Wood, Scarville, & Gravino, 1995), sleep disturbances (Blount et al., 1992; Mansfield et al., 2010; Wood et al., 1995), headaches (Blount et al., 1992; Wood et al., 1995), menstrual irregularity (Blount et al., 1992; Wood et al., 1995), fatigue (Blount et al., 1992), and insomnia (Blount et al., 1992). Although the rate of obesity and the most common health concerns among military spouses (e.g., hypertension, high cholesterol, and diabetes, Cole & Horacek, 2009), seem to have a similar prevalence to those in the general U.S. population (Cole & Horacek, 2009), obesity rates typically coincide with other reported health conditions and may be exacerbated by the frequent mobility, change in access to familiar providers, and systemic stressors that are more common in military families. These concerns cannot go unnoticed within military families or the military healthcare system. Military couples are experiencing high rates of physical symptoms and conditions, but biological factors do not entirely capture the health and functioning of military marriages. Thus, it is important to also consider the psychological and social components of health for military personnel and their spouses.

Psychological Health of Military Couples

Military personnel.

Stress, related to deployment and injuries, is associated with several psychological symptoms such as PTSD (Fischer, 2009), depression (Hoge et al., 2008), anxiety (Hoge et al., 2008), and substance abuse (Hoge et al., 2008). Approximately 17% of military personnel who have deployed to Iraq or Afghanistan experience PTSD (Hoge et al., 2008) compared to an estimated lifetime prevalence (among the general population) in the United States of 8-9% (Johnson, Maxwell, & Galea, 2009). As PTSD has become more prevalent in the military population (Fischer, 2009; Johnson, Maxwell, & Galea, 2009), suicide rates have also been higher when compared to the civilian populations (Black, Gallaway, Bell, & Elspeth, 2011).

Among active duty military personnel, suicide is the second leading cause of death (Center for Disease Control and Prevention [CDC], 2007), accounting for approximately one-fifth of deaths among active duty Air Force (ADAF) members (Yamane & Butler, 2009). Depression symptoms, a risk factor for suicide, have been shown to increase following deployment (Hoge et al., 2008). However, depression among military personnel is not only associated with deployment; approximately one-third of entry-level military personnel reported some depressive symptoms, and approximately 15% of male entry-level military personnel and 22% of female entry-level military personnel in basic training met criteria for moderate to severe major depressive disorder, which are higher rates than found in the general population (Warner et al., 2007).

Military Spouses.

Stress from deployment has also been associated with depressive disorders, sleep disorders, anxiety, acute stress reaction, and adjustment disorders in military spouses (Mansfield

et al., 2010). Spouses of military personnel who have been deployed have had more mental health diagnoses than spouses of military personnel who have not been deployed (Mansfield et al., 2010). In addition to deployment, husbands' posttraumatic stress appears to have a psychological impact on military wives. Depression (Klarić, Frančišković, Obrdalj, Petrić, Britvić, & Zovko, 2012), anxiety (Klarić et al., 2012), panic disorders (Klarić et al., 2012), dysthymia (Klarić et al., 2012), general psychological distress (Renshaw, Allen, Rhoades, Blais, Markman, & Stanlet, 2011), and suicidality (Klarić et al., 2012) have been associated with military spouses whose veteran husbands have PTSD (Klarić, et al., 2012). Stress from military life clearly contributes to the psychological functioning of military spouses and can also impact relational health and thus the marriage.

Social and Relational Health

Military personnel and their spouses are affected by stress and health conditions unique to the military lifestyle that are associated with challenges to social and relational functioning (Mansfield et al., 2010; Solomon et al., 2012). For example, military personnel report more family stress than civilian workers (Hourani et al., 2006). In particular, military personnel report more stress in their family life or relationships with their partner than civilians (Hourani et al., 2006).

More specific within the family are stressors to the couple relationship. For example, military personnel who experience war trauma (and their spouses) tend to report low relationship satisfaction (Goff, Crow, Reisbig, & Hamilton, 2005). Male military personnel who exhibit symptoms of PTSD or who sustained Traumatic Brain Injuries (TBIs) from war traumas are more likely to have poor marital adjustment (e.g., less satisfaction in their marital relationship and more disagreements with their spouse) following the TBI or trauma precipitating

the onset of PTSD (Claude Blais, & Boisvert, 2005; Dekel, Enoch, & Solomon, 2008). Additionally, there is evidence that trauma symptoms can "transmit" from male military personnel to their female spouses (Dirkzwager, Bramsen, Adèr, & Van der Ploeg, 2005) as well as from male military personnel to their children (Gibbs, Martin, Küpper, & Johnson, 2007; Rentz et al., 2007); an incredible concern in the context of relational health.

Unfortunately, the lack of research on the health and satisfaction of military couples, including both partners of the dyad, leaves many questions unanswered. With the unique stressors that military couples face, it is important to consider the potential for biological, psychological, and social factors that can affect military personnel and their spouses along with overall marital adjustment. Measuring health conditions and distress would provide valuable information about the experience of military couples as a dyad, address gaps in the literature about military couples, and determine the healthcare needs of military couples from a biopsychosocial perspective.

Methodology

Sample

Participants were married couples recruited from a military health care center, on a base in the southeastern US. Participants were recruited through IRB approved recruitment measures at the military health care center. Inclusion criteria for couples was that the couple was married, had one partner who was active duty, and neither person had a serious mental health condition (i.e., severe clinical depression, suicidal ideation assessed by the PHQ-9, severe PTSD assessed using the PTSD Checklist, serious cognitive delays, or were currently receiving marital therapy services).

Measures

Physiological (HRV), biological (physical markers, medical diagnoses), psychological (posttraumatic stress symptoms, Distress Thermometer [emotional subscale], social (Distress Thermometer [social problems subscale]), and relational (Marital Adjustment Test) factors were collected from each partner of a marital dyad.

Physiological marker.

Heart rate variability (HRV), was used to assess the physiological presence of distress, and reflected a unique aspect of the participants' physical health. HRV measures the variation of time between consecutive heartbeats and can show the status of the autonomic nervous system. Sympathetic activity decreases the inter-heartbeat interval and parasympathetic activity increases the inter-heartbeat interval (Thayer, Åhs, Fredrikson, Sollers III, & Wager, 2012). This project uses SDNN as a measure of HRV. SDNN, the standard deviation of normal-to-normal QRS heartbeat intervals (whereby high SDNN reflects low physiological distress and low SDNN reflects high physiological distress), is the standard HRV variable that is used most often in HRV research (Hassett et al., 2007; Lehrer et al., 2004; Tan et al., 2009; Umetani, Singer, McCraty, & Atkinson, 1998). HRV has been used in research with military personnel in France and veterans in the U.S. (Jouanin, Dussault, Peres, Satabin, Pierard, & Guezennec, 2004; Tan, Dao, Farmer, Sutherland, & Gevirtz, 2011) and most recently with military couples as the unit of analysis (Lewis, Lamson, White, Russoniello, Ivanescu, 2012).

Biomarkers.

Biomarkers for this study included blood pressure, height, weight, and body mass index (BMI). The height, weight, and blood pressure of the participants were measured and BMI was calculated using the height and weight measurements. To capture biological health conditions,

participants were asked to self-report their current health conditions. Health conditions were measured by a question in the demographic section of the assessment packet that asked, "Please list all of your current medical health diagnoses."

Psychosocial markers.

The PTSD Checklist (PCL) was used to assess posttraumatic stress symptoms. Two versions of the PTSD Checklist were used; the PCL-M for military personnel and the PCL-C for civilians. Both versions consist of 17 questions with a 5-point Likert scale, with one indicating "not at all" and five indicating "extremely." The Distress Thermometer is another measure that was used in the study (α=.83 for husbands, α=.69 for wives), which captures biological, psychological, and social functioning via self-report. It was originally developed to assess distress of cancer patients from five stress domains: practical, family, emotional, physical, and spiritual (Mitchell, 2010). The Distress Thermometer includes a 10-point Likert scale to assess global distress, with zero indicating "no distress" and ten indicating "extreme distress". The Distress Thermometer includes a "problem list" that is a table of 37 areas that relate to the five stress domains. Participants are asked to check yes or no next to each distress factor if the factor had been a cause of distress in the past week. This study focused on the "emotional problems" subscale and the "social problems" subscale (comprised of the family and practical problems questions).

For detecting distress, the Distress Thermometer has a sensitivity (i.e., ability to detect the presence of distress) of 78.3%, and a specificity (i.e., ability to identify the absence of distress) of 66.5% (Mitchell, 2010). Of the publications that have cited research using the Distress Thermometer, (Mitchell, 2010) none have documented the use of the measure with military populations. However, more research on the Distress Thermometer has been published

recently (Artherholt & Fann, 2011; Ford & Mann, 2012), giving credibility to its usefulness in better understanding biopsychosocial health.

Relational markers.

To capture the relational health of couples, the Locke-Wallace Marital Adjustment Test (MAT) was used. The MAT, which measures marital relationship adjustment, has been used widely since its development in 1959 (Freeston & Pléchaty, 1997). The MAT assesses relationship adjustment, agreement and disagreement on issues (e.g., finances), and relationship style. The MAT has high internal reliability and adequate internal consistency (Freeston & Pléchaty, 1997). The MAT has been used in research with veterans and their spouses (Sherman, Sautter, Jackson, Lyons, & Han, 2006), making it an important marital assessment for this study. The administration of the MAT in the Sherman et al. study is similar to the present study's administration; each partner filled out separate questionnaires and was not able to see one another's responses (2006). Sherman et al. did not report a coefficient of reliability for use of the MAT with their veterans and spouses sample (2006), however the MAT has been found to have a reliability of α=.90 among a sample of 236 marriages (Locke & Wallace, 1959). The reliability for the MAT in the sample used in this study was α=.68 for husbands and α=.79 for wives.

Procedure

For the purpose of the current study, data collection occurred during one visit with the military personnel and his spouse at the medical facility. Data collection occurred in a private room in the medical clinic with the researcher and the couple. Physical markers (height, weight, blood pressure) were measured separately for each partner by the researcher during the research appointment with the couple. Next, one spouse completed the pen and paper questionnaire and assessments while the other spouse completed a 12 minute HRV assessment administered by the

researcher using a finger sensor and *HRV Live!* software. The finger sensor detected and recorded participants' heart rate variability for 12 minutes and the software provided a report of participants' heart rate variability, including SDNN.

Research Hypotheses

Participants were divided into four groups based on quartiles of the standard deviation of normal-to-normal (SDNN) (a component of HRV that will be described more completely in the next chapter) whereby the upper quartile reflects low physiological distress and the lower quartile reflects high physiological distress. The hypotheses are as follows:

1. Heart rate variability, measured as SDNN will be associated with biological, psychological, and social markers:
    a. The SDNN of couples in which the husband and wife are both in the lower quartile of SDNN will have higher BMI, blood pressure, and frequency of medical conditions than couples in which the husband and wife are in the upper quartile of SDNN.
    b. The SDNN of couples in which the husband and wife are both in the lower quartile of SDNN will have a higher frequency of emotional problems, PTSD symptoms, and general distress than couples in which the husband and wife are in the upper quartile of SDNN.
    c. The SDNN of couples in which the husband and wife are both in the lower quartile of SDNN will have a higher frequency of family problems and practical problems than couples in which the husband and wife are in the upper quartile of SDNN.

2. Couples in the bottom quartile of SDNN will have low scores on the Marital Adjustment Test, and couples in the upper quartile of SDNN will have high scores on the Marital Adjustment Test. Couples in which the husband and wife are in different quartiles will have low scores on the Marital Adjustment Test compared to couples in the same quartiles.
3. SDNN will moderate the relationship between biopsychosocial markers and marital adjustment:
    a. SDNN will strengthen the relationship between biopsychosocial markers and marital adjustment for couples in which the husband and wife are in the lower quartile of SDNN.
    b. SDNN will strengthen the relationship between biopsychosocial markers and marital adjustment for couples in which the husband and wife are in the upper quartile of SDNN.
    c. SDNN will weaken the relationship between biopsychosocial markers and marital adjustment for couples in which the husband and wife are in different quartiles of SDNN.
    d. SDNN will weaken the relationship between biopsychosocial markers and marital adjustment for couples in which the husband and wife are in the same quartiles of SDNN.

Analysis

Participants were sorted into quartiles, separated by wives and husbands, based on the distribution of SDNN. SDNN is a measure of HRV that is used most often in HRV research, and it is regarded as the most "straightforward" measure of HRV (Hassett et al., 2007; Lehrer et al.,

2004; Tan et al., 2009; Umetani, Singer, McCraty, & Atkinson, 1998). SDNN analysis using quartiles is commonly used in HRV research (Christensen, Schmidt, Mølenberg, & Toft, 2005; de Bruyne et al., 1999; Liao, Carnethon, Evans, Cascio, & Heiss, 2002) including research with military and veteran populations (Aslani, Aslani, Kheirkhah, & Sobhani, 2011; Bilchick et al., 2002). Several studies have utilized the lowest quartile of SDNN as a basis for comparison (Aslani et al., 2011; Christensen et al., 2005; Bilchick et al., 2002; de Bruyne et al., 1999; Liao et al., 2002).

SDNN, the independent variable of interest, is dichotomized by the lower quartile (lowest 25% of SDNN) versus the higher quartile (highest 25% of SDNN). Comparisons between SDNN lower and upper quartile groups were made using the Mann-Whitney U test as appropriate for the non-normal distribution of SDNN. The Mann-Whitney U test is appropriate for small samples and ordinal variables (Nachar, 2008). The Mann-Whitney U test determines if the variable of one group is "stochastically" larger than another group (Nachar, 2008).

For hypothesis one, the Mann-Whitney U test was used to determine if participants in the lower quartile of the SDNN distribution had higher BMI, blood pressure, frequency of medical conditions, frequency of emotional problems, PTSD symptoms, general distress, and frequency of family problems and practical problems than participants in the upper quartile of the SDNN distribution. Blood pressure was analyzed as two continuous variables, systolic and diastolic, consistent with previous studies (Baker et al., 2000; Carels, Sherwood, Szczepanski, & Blumenthal, 2000; Heffner, Kiecolt-Glaser, Loving, Glaser, & Malarkey, 2004).

For hypothesis two, the Mann-Whitney U test was used to determine if couples in the lower quartile of SDNN have lower Marital Adjustment Test scores than couples in the upper quartile of SDNN. For the second part of hypothesis two, the Mann-Whitney U test was used to

determine if couples with partners in different quartiles have lower scores on the Marital Adjustment Test compared to couples with both partners in the same quartile.

For hypothesis three, multiple regression analyses were used to determine if SDNN was a significant moderator for the relationship between the biopsychosocial markers (BMI, blood pressure, frequency of medical conditions, frequency of emotional problems, PTSD symptoms, general distress, and frequency of family problems and practical problems) and marital adjustment for couples in the same quartile, and a non-significant moderator for couples in different quartiles.

Results

Preliminary Tests

Standard frequency and descriptive tests were completed on demographic data of the sample, which included 66 couples (Table 1). Data was collected on 76 couples at the time of analysis, but five couples were excluded for exceeding mental health cutoffs and an additional five couples were excluded for participation in marriage and family therapy for marital issues. The average age of husbands was 36 years and the average age of wives was 35 years. The majority of the sample identified as White (72.7% of husbands, 65.2% of wives), 16.7% of husbands identified as African American, 6.1% of wives identified as African American, 10.5% of husbands identified as Hispanic, biracial, or "other", and 22.8% of wives identified as Hispanic, Asian American, or "other". Eighty-five percent of husbands and 72.7% of wives had at least some college education. Typically military couples consist of a male military personnel and a female spouse, but that was not always the case for the couples in this study. Ninety-five percent of husbands in the study were in the military and 24% of wives were in the military. Bivariate correlations were completed to explore relationships between variables for husbands

and wives for all 66 couples (Table 2), with means and standard deviations for variables as a function of gender presented in Table 3 and skewness and kurtosis for variables presented in Table 4. There were some differences in relationships between biopsychosocial variables for husbands and wives.

The number of reported medical conditions was significantly correlated with BMI for both husbands ($r(64)= .41, p<.01$) and wives ($r(64)= .36, p<.01$). As BMI increased for husbands and wives, the number of reported medical conditions also increased. For husbands, BMI was significantly correlated with systolic ($r(64)=.27, p < .05$) and diastolic ($r(64)= -.30, p < .05$) blood pressure, meaning that as BMI increased, maximum blood pressure during ventricular contraction (systolic) (Alexis, 2010) was likely to also increase, and the minimum blood pressure during aortic valve closure (diastolic) (Alexis, 2010) was likely to decrease. The same relationship was not significant for wives. For wives, however, global distress was significantly related to the number of reported medical conditions ($r(64)= .29, p<.05$), but there was no significant correlation for the relationship between global distress and medical conditions for husbands ($r(64)=.00$). Wives' family problems were significantly correlated with systolic ($r(64)= .28, p<.05$) and diastolic ($r(64)= .27, p<.05$) blood pressure, meaning that as the frequency of family problems increased for wives, their maximum blood pressure during ventricular contraction (systolic) (Alexis, 2010) was likely to also increase, and the minimum blood pressure during aortic valve closure (diastolic) (Alexis, 2010) was likely to increase. The same relationship was not significant for husbands.

For wives, global distress was significantly correlated with emotional distress ($r(64)= .52, p<.01$) and family problems ($r(64)= .42, p<.01$), but not with practical problems ($r(64)=.23$). For husbands, global distress was significantly associated with emotional distress ($r(64)= .54,$

$p<.01$) and practical problems ($r(64)= .54, p<.01$) but not family problems ($r(64)=.20$). For wives, PTS symptoms were significantly associated with global ($r(64)= .34, p<.01$) and emotional ($r(64)= .45, p<.01$) distress but not family or practical problems. For husbands PTS symptoms were significantly associated with global ($r(64)= .52, p<.01$) and emotional ($r(64)= .49, p<.01$) distress and family ($r(64)= .29, p<.01$) and practical problems ($r(64)= .40, p<.01$). This indicated that husbands experienced more PTS symptoms when they were also experiencing social and emotional distress.

Marital adjustment was significantly correlated with global distress for husbands ($r(64)= -.28, p<.05$) and wives ($r(64)= -.29, p<.05$), and with family problems for husbands ($r(64)= .47, p<.01$) and wives ($r(64)= -.50, p<.01$). Additionally, marital adjustment was significantly correlated with SDNN for wives ($r(64)= -.34, p<.01$), but not for husbands ($r(64)= -.14$). The exploration of correlational relationships showed that different relationships between stressors exist when comparing husbands and wives. Means and standard deviations of study variables as a function of gender are shown in Table 3. On average, wives reported slightly more emotional distress and family problems than husbands, and had slightly lower scores on the marital adjustment test. Husbands had slightly higher SDNN than wives.

Bivariate correlations were completed to explore relationships across husbands' and wives' biopsychosocial variables. Significant correlations were found across wives' and husbands' biological variables, psychosocial variables, and marital adjustment. Wives' and husbands' systolic blood pressures were significantly correlated ($r(64)= .31, p<.05$). Husbands' SDNN was significantly associated with wives' diastolic blood pressure ($r(64)= .29, p<.05$). Additionally, husbands' frequency of medical conditions was significantly correlated with wives' systolic ($r(64)= .28, p<.05$) and diastolic ($r(64)= .30, p<.05$) blood pressure. These

findings related to husbands and wives' biological variables were statistically significant, but do not have clear clinical significance.

For cross correlations with husbands' and wives' psychosocial variables, husbands' global distress was significantly correlated with wives' PTS symptoms ($r(64)= .50, p<.01$) and emotional distress ($r(64)= .33, p<.05$). Husbands' family problems were significantly associated with wives' global distress ($r(64)= .40, p<.01$) and family problems ($r(64)= .51, p<.01$). When husbands experienced many family problems, wives were also likely to experience many family problems. Wives' and husbands' practical distress was also significantly correlated ($r(64)= .32, p<.01$), meaning that when husbands experienced practical problems, their wives were also likely to experience practical problems.

For the relational variable of this study, marital adjustment, husbands' and wives' marital adjustment scores were significantly associated ($r(64)= .57, p<.01$), meaning that as husbands marital adjustment increased (indicating high relationship satisfaction, couple cohesion, and satisfactory conflict resolution), wives marital adjustment was also likely high. Husbands' marital adjustment was negatively associated with wives' global distress ($r(64)= -.26, p<.05$) and family problems ($r(64)= -.33, p<.01$), indicating that wives with high global distress or family problems were associated with husbands with poor marital adjustment. A similar trend existed for wives' marital adjustment which was negatively associated with husbands' family problems ($r(64)= -.43, p<.01$).

SDNN Quartile Distribution

The distribution of SDNN, the standard deviation of normal-to-normal QRS heartbeat intervals (Appendix B), was used for analysis. The lower quartile (lowest 25% of SDNN) indicates high physiological distress, and the upper quartile (highest 25% of SDNN) indicates

low physiological distress. For husbands, the lower quartile was composed of an SDNN at 42.45 or below. The upper quartile consisted of husbands whose SDNN was 83.55 or above. There were 16 husbands in the upper quartile and 16 husbands in the lower quartile. Means and standard deviations of study variables based on gender and quartile are shown in Table 4. There were no significant outliers among husbands' SDNN; all husbands' SDNN were within four standard deviations of the mean. For wives, the lower quartile began at SDNN of 32.2 and the upper quartile began at 67.5. There was one outlier among the wives SDNN, which was 5.7 standard deviations beyond the mean, and the couple was excluded from quartile analysis. There were 15 wives in the upper quartile, indicating that they were experiencing low physiological distress, and 16 wives in the lower quartile, indicating that they were experiencing high physiological distress. Means and standard deviations as a function of gender and quartile are presented in Table 4, and medians and interquartile ranges as a function of gender and quartile are presented in Table 5.

Since the sample for this study was limited, all couples were included in the quartile analysis regardless of couple type (military-military, husband military only (HMO), wife military only), which could be a confounding variable in quartile analysis. Differences based on couple type were examined for husbands and wives in the upper and lower quartiles. For the 15 wives in the upper quartile, 12 were HMO couples and three couples were dual-military couples. For these wives in the upper quartile, significant differences were found between couple types for marital adjustment and frequency of medical conditions using Mann-Whitney U tests. For upper quartile wives in HMO couples, the median marital adjustment was 124 and the median number of medical conditions was zero. Medians are reported because medians are used in the analysis using Mann-Whitney U tests. For upper quartile wives in dual-military couples, the median

marital adjustment was 89 and the median number of medical conditions was two. Upper quartile wives in HMO couples had significantly higher marital adjustment than wives in the lower quartile; the median of upper quartile wives, 124, is in the "high" range for marital adjustment, while the median of lower quartile wives, 89, is in the "moderate" range for marital adjustment (Locke & Wallace, 1959).

For wives in the lower quartile of SDNN, there were four from dual-military couples, 11 from male military only couples, and one from a wife military only couple. Mann-Whitney U tests were conducted to compare the dual-military and traditional couples. There was not a significant difference between couple types for PTS symptoms for wives in the upper quartile. Wives in the upper quartile in dual-military couples had a median of 17 on the PTS symptom assessment, and wives in the upper quartile in HMO couples had a median of 23. Although the difference in PTS symptoms is not significant, neither median is clinically significant.

For husbands in the upper quartile of SDNN there were two from dual-military couples, 12 from HMO couples, and two from wife military only couples. There were no significant differences across couple type for the biopsychosocial variables for husbands in the upper quartile of SDNN. For husbands in the lower quartile of SDNN there were two from dual-military couples, 13 from HMO couples, and one from a wife only military couple. There were no significant differences across couple type for the biopsychosocial variables for husbands in the lower quartile of SDNN.

For dyadic quartile analysis, there were 12 couples with husband and wife in the same quartile (upper or lower) and six couples with the husband and wife in different quartiles (upper or lower). Of the 12 couples in the same quartile, eight were in the lower quartile of SDNN and four were in the high quartile of SDNN. This means that of the 66 couples included in analysis,

eight couples were experiencing high physiological distress as a dyad and four couples were experiencing low physiological distress.

Hypothesis One

Mann-Whitney U tests revealed that upper SDNN quartile couples and lower SDNN quartile couples did not significantly differ on BMI, blood pressure, frequency of medical conditions, frequency of emotional problems, PTSD symptoms, general distress, and frequency of family problems and practical problems. Additional analysis was completed to determine if the study variables differed by upper and lower quartile wives (N=15 and 16, respectively) and upper and lower quartile husbands (N=16) (without grouping couples by being in the same quartile). However, no significant differences were found using the Mann-Whitney U Test between wives in the upper and lower quartiles or between husbands in the upper and lower quartiles. For this hypothesis, couples with high physiological distress based on HRV did not differ significantly from couples with low physiological distress on biopsychosocial study variables.

Hypothesis Two

A Mann-Whitney U test showed that there was no significant difference in husbands' and wives' marital adjustment between couples in the upper SDNN quartile and couples in the lower SDNN quartile. Additional analyses were completed to determine if the upper and lower quartile wives and upper and lower quartile husbands (not grouping by couples' position in quartiles) differed in their marital adjustment, but no significant differences were found using the Mann-Whitney U Test. Couples with high physiological distress did not differ significantly in marital adjustment from couples with low physiological distress.

Hypothesis Three

To prepare for analysis to determine if SDNN had a moderating effect on biopsychosocial variables and husbands and wives' marital adjustment, standard regression analysis was completed to explore prominent relationships; and significant findings were revealed. Since there were only eight couples in the upper quartile and four couples in the lower quartile, not all biopsychosocial variables of interest could be used in multiple regression analysis. From preliminary bivariate correlation analysis (see Table 2), marital adjustment was significantly associated with global distress, PTS symptoms, and family problems for husbands. For wives, marital adjustment was significantly associated with global distress, family problems, and SDNN. Standard regression was completed for husbands and wives in the lower quartile to determine if the significant variables had a predictive relationship with marital adjustment. There were no significant predictors in the model for husbands or wives in the lower quartile. Standard regression analysis could not be completed for husbands and wives in the upper quartile because there were only four couples in the upper quartile.

Additional analyses were completed to determine if SDNN was a moderator for the relationship between biopsychosocial variables and marital adjustment for all wives and all husbands. For the wives, their global distress and family problems significantly predicted their marital adjustment ($F(2, 53)= 10.93$, $p.\leq 001$) and the model was significant when SDNN was added as a moderator ($F(3, 52)= 14.1$, $p.\leq 001$); the total model explained 67% of the variance in wives' marital adjustment (Table 6). In the models predicting marital adjustment for husbands, PTS symptoms, global distress, and family problems significantly contributed to predicting marital adjustment ($F(3, 56)= 6.68$, $p.\leq 001$) and the model was significant when SDNN was

added as a moderator ($F(4, 55)= 5.20, p.\leq 001$); the model predicted 52% of the variance in husband's marital adjustment (Table 7).

Discussion

The goal of this study was to assess the biopsychosocial health of military couples and explore the relationships between biopsychosocial health factors, marital adjustment, and physiological distress for military couples. Previous literature has found that hypertension and obesity are concerns for military personnel (Almond et al., 2008; Granado et al., 2009; Kress, Peterson, & Hartzell, 2006) and their spouses (Cole & Horacek, 2009). This study found that the mean systolic and diastolic blood pressures for husbands and wives were normal (Alexis, 2010), but the military personnel's mean BMI, 28.51 (SD=4.16) is considered overweight, and their spouses mean BMI, 30.14 (SD= 12.15) is considered obese (James-Enger, 2009).

Second, PTSD has been shown to affect the physical and social functioning of military personnel (Fischer, 2009; Johnson, Maxwell, & Galea, 2009), and can also have an impact on military spouses (Hoge et al., 2008; Mansfield et al., 2010). Couples in the present study did not have clinically significant PTS symptoms, even when compared across levels of physiological distress. However, one interesting finding related to PTS symptoms was that civilian wives with high physiological distress, as indicated by being in the lower quartile of SDNN, had significantly more PTS symptoms than wives with high physiological distress who were military personnel.

Overall, physical and emotional stress related to the military lifestyle has been associated with challenges to personal and relational functioning for military couples (Mansfield et al., 2010; Solomon et al., 2012). Previous studies have shown that wives experience biopsychosocial distress when their husbands are deployed (Klarić et al., 2012; Mansfield, 2010; Renshaw et al.,

2011), and that wives experience psychological distress when their husbands have PTSD (Dirkzwager et al., 2005). Husbands in this study were not deployed and wives typically had more emotional distress and poorer marital adjustment than their husbands, but their distress was not found to be associated with their husbands PTS symptoms. Similar to previous studies, results from this study showed that there were associations between husbands' and wives' personal and relational health. In general, husbands' marital adjustment was associated with wives' psychosocial distress and vice versa. These associations between personal and relational health can be used to understand and support military couples in healthcare.

Implications

A systemic focus in military healthcare could benefit military personnel and their families. Instead of only treating an individual's needs and symptoms, such as a military personnel's PTSD or TBI, healthcare providers should consider how the individual's needs and symptoms impact the family system and shape treatment around the system rather than the individual. Research has shown that an individual's health is associated with family relationships (Kiecolt-Glaser, 1999; Kiecolt-Glaser & Newton, 2001). Systemic treatment in healthcare could be as simple as including a spouse at medical appointments. This would be beneficial for military personnel and their families since findings from previous literature and this study have shown that military personnel are facing a variety of biological, psychological, and social challenges, which are interrelated and potentially impact the marriage and the family.

Future research should continue to explore the associations detected between biological, psychological, and social variables for husbands and wives and the potential predictive relationship between psychosocial markers, physiological markers, and marital health. Researchers should continue to explore these relationships, and complete analyses to further

assess the predictive relationship with a larger sample of military couples. Researchers should also explore how biopsychosocial health and distress differs across military couple types, such as couples in which the wife is the military personnel or the husband and wife are both military personnel. Finally, HRV assessment, especially using SDNN, should continue to be used in biopsychosocial research to capture physiological distress, which can be a response to biological, psychological, and social factors (Acharya et al., 2006; Boysen, Lewin, Hecker, Leichter, & Uhlemann, 2007; Licht, de Geus, Zitman, Hoogendiik, van Dyck, & Penninx, 2008; Smith et al., 2011; Tan et al., 2011; Thayer & Lane, 2007).

Limitations

This study used a convenience sample and relied on some self-report data. As a result of the sample size in this study, some analyses could not be completed to explore the predictive relationships between study variables and the generalizability of these results is limited. Additionally, ten couples that completed assessments were excluded, approximately one-seventh of the total sample. Half of the couples excluded exceeded mental health cutoff, and the other half were couples receiving marriage and family therapy. If this study was able to look at those couples that were excluded because of being in marriage and family therapy, results could have captured the biopsychosocial experience of couples with distress so significant that they had already sought treatment.

Conclusion

There has been a lack of research exploring the interaction between the biological, psychological, and social factors affecting military couples. This study makes a unique contribution to the literature by exploring how physiological distress is related to the biopsychosocial and marital health of military couples. This study was useful in showing that

biological distress in military couples is associated with psychological or social stress, and vice versa. Furthermore, the associations between types of stress seem to differ for husbands and wives. For example, PTS symptoms in husbands were associated with more distress factors than in wives, and wives', but not husbands', physiological distress was associated with marital adjustment. This study brought the biopsychosocial model to life by illustrating the connections between biological, psychological, and social health in military couples. Given these findings, it is clear that military couples could benefit from further clinical, research, and policy efforts to better address their individual and dyadic biopsychosocial needs.

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Table 1. *Demographic information for husband , wife, and couple.*

Indicator	Frequency(%) or Mean(SD)	
	Husband	Wife
Age (Average)	36.02(10.57)	35.08(10.78)
Race		
Non-Hispanic White	48(72.7%)	43(65.2%)
African-American	11(16.7%)	4(6.1%)
Hispanic	3(4.5%)	5(7.6%)
Asian-American	---	4(6.1%)
Biracial	1(1.5%)	---
Other	3(4.5%)	6(9.1%)
Education		
Grade 9-11	---	4(6.1%)
GED/HS Diploma	10(15.2%)	13(19.7%)
Some College	44(66.7%)	34(51.5%)
College Graduate	11(16.7%)	13(19.7%)
Graduate School	1(1.5%)	1(1.5%)
Military Personnel		
Military	63(95.5%)	16(24.2%)
Civilian	3(4.5%)	50(75.8%)
Time in Service in Years (Average)	12.81(7.86)	8.59(7.95)
Couple Types		
Military-Military	12(18.2%)	
Husband military only	51(77.3%)	
Wife military only	3(4.5%)	

Table 2. *Bivariate Correlations for Husbands (above the diagonal) and Wives (below the diagonal)*

	1	2	3	4	5	6	7	8	9	10	11
1. Systolic	_	.80**	.267*	.379**	-.01	-.07	-.07	-.01	-.07	-.01	-.13
2. Diastolic	.84**	_	-.30*	.46**	.09	-.06	.02	.07	.06	-.07	-.09
3. BMI	.11	.14	_	.41**	.01	.07	-.07	.03	.09	.02	-.25
4. Med. Cond.	.07	.07	.36**	_	.00	.08	.01	.17	-.02	-.15	-.22
5. Distress Thermom	-.07	-.01	-.11	.29*	_	.54**	.52**	.20	.54**	-.28*	-.02
6. Emotional Distress	.20	.23	.04	.02	.52**	_	.49**	.38**	.54**	.13	-.04
7. PTSD	.04	.04	.10	.18	.34**	.45**	_	.29*	.40**	.32*	-.03
8.Family Problems	.28*	.27*	.24	.11	.42**	.21	.13	_	.07	.47**	-.8
9. Practical Problems	.05	-.14	.01	-.11	.23	.25*	.20	.06	_	-.18	.00
10. MAT	-.22	.04	.01	.18	-.29*	-.25	-.22	-.50**	-.24	_	-.14
11. SDNN	-.14	-.25*	-.19	-.24	.11	.04	.05	-.11	.09	-.34**	_

*p < .05. **p < .01. ***p < .001.

Table 3. *Mean Scores and Standard Deviations as a Function of Gender for All Indicators*

Item		Husbands (N=66) M(SD)	Wives (N=66) M(SD)
Physical Health			
	Systolic	122.34(12.43)	116.13(13.98)
	Diastolic	77.05(8.23)	75.39(8.11)
	BMI	28.51(4.16)	30.14(12.15)
	Freq. Medical Cx	1.32(1.67)	1.09(1.41)
Emotional Health			
	Distress (Analog)	2.38(2.35)	3.43(2.63)
	Distress (Emotional)	.89(1.34)	1.26(1.43)
	PTSD	21.21(7.00)	22.75(7.95)
Social Health			
	Family Problems	.26(.56)	.43(.64)
	Practical Problems	.97(.97)	.91(1.04)
Marital Health			
	MAT	120.58(21.06)	117.67(24.71)
Physiological			
	SDNN	69.40(35.21)	53.76(35.43)

Table 4. *Skewness and Kurtosis as a Function of Gender for All Indicators*

Item		Husbands (N=66)	Wives (N=66)
		Skewness (SE), Kurtosis (SE)	Skewness (SE), Kurtosis (SE)
Physical Health			
	Systolic	.47(.30), -.07(.59)	1.00(.30), 1.20(.59)
	Diastolic	-.05(.30), 1.54(.59)	.56(.30), 1.28(.59)
	BMI	.63(.30), .92(.59)	4.44(.30), 27.30(.58)
	Freq. Medical Cx	1.24(.30), .96(.59)	1.34(.31), .98(.62)
Emotional Health			
	Distress (Analog)	.83(.30), -.37(.59)	.52(.30), -.46(.50)
	Distress (Emotional)	1.51(.30), 1.55(.58)	.97(.30), .08(.60)
	PTSD	2.47(.30), 6.65(.59)	2.47(.30), 6.65(.59)
Social Health			
	Family Problems	2.13(.30), 3.54(.59)	1.21(.30), .37(.59)
	Practical Problems	.92(.30), .49(.59)	.96(.30), .12(.59)
Marital Health			
	MAT	-.83(.30), 1.30(.59)	-1.20(.31), 1.93(.61)
Physiological			
	SDNN	1.05(.30), .60(.60)	.63(.30), .92(.59)

Table 5. *Mean Scores and Standard Deviations as a Function of Gender and Quartile for All Indicators*

Item		Lower Quartile Husbands (N=16) M(SD)	Upper Quartile Husbands (N=16) M(SD)	Lower Quartile Wives (N=16) M(SD)	Upper Quartile Wives (N=15) M(SD)
Physical Health					
	Systolic	121.0(7.27)	122.13(12.15)	118.19(12.71)	119.23(14.96)
	Diastolic	76.25(5.71)	76.25(7.13)	77.75(8.09)	75.07(7.31)
	BMI	30.12(4.69)	27.39(4.55)	37.13(20.86)	29.00(6.02)
	Freq. Medical Cx	1.27(1.22)	.63(1.20)	1.93(1.67)	.71(.83)
Emotional Health					
	Distress (Analog)	2.53(2.47)	2.06(2.32)	3.69(3.00)	4.21(2.52)
	Distress (Emotional)	.81(1.33)	.63(.96)	1.00(1.24)	2.0(1.60)
	PTSD	20.13(3.30)	20.13(6.26)	23.00(7.26)	23.87(8.18)
Social Health					
	Family Problems	.13(.34)	.31(.60)	.53(.64)	.53(.74)
	Practical Problems	.80(.94)	.94(.85)	.87(1.09)	1.27(1.28)
Marital Health					
	MAT	128.69(17.02)	119.67(21.94)	124.64(18.41)	105.71(32.60)
Physiological					
	SDNN	33.70(5.74)	120.63(25.20)	25.45(5.68)	86.03(18.52)

Table 6. *Medians and Interquartile Ranges as a Function of Gender and Quartile for All Indicators*

		Lower Quartile Husbands (N=16)	Upper Quartile Husbands (N=16)	Lower Quartile Wives (N=16)	Upper Quartile Wives (N=15)
Item		Median(IQR)	Median(IQR)	Median(IQR)	Median(IQR)
Physical Health					
	Systolic	119.5(7.5)	123.5(7.25)	114.5(14.5)	122(5.5)
	Diastolic	76.5(3.5)	77(4.75)	78(5.75)	74(6)
	BMI	28.55(4.53)	26.51(4.17)	32.61(6.65)	28.58(2.14)
	Freq. Medical Cx	1(1)	0(1)	1(3)	.5(.75)
Emotional Health					
	Distress (Analog)	2(1)	1.5(1.5)	3(3.75)	4(2.25)
	Distress (Emotional)	0(1)	0(1)	1(.25)	2(1)
	PTSD	19(3)	18(1.75)	21(4)	21(3)
Social Health					
	Family Problems	0(0)	0(.75)	0(1)	0(1)
	Practical Problems	1(0)	1(1)	.5(1.25)	1(1)
Marital Health					
	MAT	133(8.5)	118(12)	124(11.25)	112(18.75)
Physiological					
	SDNN	34.15(4.3)	116.8(24.73)	27.55(1.5)	85.2(9.3)

Table 7. *Standard Regression Analyses Predicting MAT for Wives*

	Wives MAT	
	Model1	Model 2
	β (SEβ)	β (SEβ)
1. Family Problems	-17.3(4.83)***	-18.73(4.32)***
2. Global Distress	-1.31(1.18)	-1.41(1.05)
3. SDNN		-.39(.103)***
Model F	(2,53) 10.93***	(3,52) 14.1***
R	.54	.67
R^2	.29	.45

*p < .05. **p < .01. ***p < .001

Table 8. *Standard Regression Analyses Predicting MAT for Husbands*

	Husbands MAT	
	Model1	Model 2
	β (SEβ)	β (SEβ)
1. Family Problems	-15.69(4.49)***	-15.34(4.49)***
2. Global Distress	-.86(1.21)	-.86(1.21)
3. PTS Symptoms	-.39(.41)	-.41(.41)
4. SDNN		-.06(.07)
Model F	(3,56) 6.68***	(4,55) 5.20***
R	.51	.52
R^2	.26	.27

*p < .05. **p < .01. ***$p \leq$ .001

CHAPTER FIVE: DISCUSSION

The goal of this study was to examine the biopsychosocial distress of military personnel and their spouse and explore the relationship between couples' biopsychosocial health and their physiological distress. Previous literature has explored the biological, psychological, and social health of military couples as independent health factors and has shown that military couples experience high levels of stress and experience various health conditions as a result of a military lifestyle.

Chapter one presented an overview of the military population and the challenges that military couples face. Over half of the 1.4 million active duty military personnel are married (Department of Defense (DOD), 2012), and they and their spouses experience a disproportionate amount of health conditions and stress related to military lifestyle (Black, Gallaway, Bell, & Elspeth, 2011; Hourani, Williams, & Kress, 2006; Mansfield, Kaufman, Marshall, Gaynes, Morrisey, & Engel, 2010).

Chapter two demonstrated how there is a gap in the literature, and a need for a research assessing the biopsychosocial health of military couples. The biopsychosocial model was introduced as a way to view military couples and their health. Previous researchers have shown that military personnel experience physical and mental health conditions related to the military lifestyle such as chronic pain (Macey, Morasco, Duckart, & Dobscha, 2011; Otis, Gregor, Hardway, Morrison, Scioli, & Sanderson, 2010), hypertension, (Granado et al., 2009), obesity (Kress, Peterson, & Hartzell, 2006), traumatic brain injuries (TBIs) (Fischer, 2009), posttraumatic stress disorder (PTSD; Hoge, Castro, Messer, McGurk, Cotting, & Koffman, 2008), and sleep challenges (Germain et al., 2012). Military spouses also experience physical and mental health conditions that need to be addressed in military healthcare such as obesity

(Cole and Horacek, 2009), hypertension (Cole & Horacek, 2009), diabetes (Cole & Horacek, 2009), high cholesterol (Cole & Horacek, 2009), anxiety (Mansfield, Kaufman, Marshall, Gaynes, Morrisey, & Engel, 2010), depression (Mansfield et al., 2010), and sleep disturbances (Mansfield et al., 2010). Researchers have shown that these biological and psychological challenges that military personnel and their spouses face can impact their marital quality (Goff, Crow, Reisbig, & Hamilton, 2005) and adjustment (Claude Blais, & Boisvert, 2005; Dekel, Enoch, & Solomon, 2008). Additionally, a military personnel's PTSD has been shown to affect the functioning of the individual, the marital relationship, and the family (Dirkzwager, Bramsen, Adèr, & Van der Ploeg, 2005; Galovski & Lyons, 2004; Hourani et al., 2006).

Chapter three presented the methodology for the study; including information on sample recruitment, the procedure, measures, and analysis. Heart rate variability was used in this study as an assessment of physiological distress, because it can be a response to biological (Acharya et al., 2006; Boysen, Lewin, Hecker, Leichter, & Uhlemann, 2007; Thayer & Lane, 2007), psychological (Licht, de Geus, Zitman, Hoogendiik, van Dyck, & Penninx, 2008; Tan et al., 2011), and social (Smith et al., 2011) stressors. This study used a unique analysis to determine the relationships between physiological distress and biopsychosocial variables by comparing couples experiencing high or low physiological distress based on quartile distribution, and also by using a physiological marker, SDNN, as a moderator for relationships between psychosocial variables.

Chapter four was constructed as a journal article including the findings from the literature, the methodology of the study, and the results from analyses of 66 military couples. This study provided a unique perspective by bringing together biological, psychological, and social variables of the couple dyad and exploring couples' health using heart rate variability.

Insight gained from this study will help military healthcare providers better understand and holistically treat military couples facing stress in an integrated care environment.

Similar to previous literature, results from this study showed that for both husbands and wives in a military couple, experiencing biological, psychological, or social stress, was associated with also experiencing another type of biological stress or psychological or social distress. Different from previous literature (Claude Blais, & Boisvert, 2005; Dekel, Enoch, & Solomon, 2008; Goff, Crow, Reisbig, & Hamilton, 2005), results from this study did not show a relationship between husbands' posttraumatic stress (PTS) symptoms and wives' marital adjustment. In exploring the differences in biopsychosocial variables of husbands and wives with high and low physiological distress, it was apparent that there were differences in the means of biopsychosocial health markers between those with high physiological distress and low physiological distress, but the differences were not statistically significant. This is a unique contribution to the literature, although future research should further explore these differences with a larger sample of military couples. A statistically significant finding from this study existed for wives and husbands and variables predicting their marital adjustment. For wives, the number of family problems and global distress, when moderated by SDNN, predicted their marital adjustment. For husbands, the number of family problems, global distress, and PTS symptoms predicted their marital adjustment when moderated by SDNN. This means that SDNN, a physiological marker, strengthened the relationship between emotional and social markers predicting a relational marker (marital adjustment).

This study is significant in the field of Marriage and Family Therapy and Medical Family Therapy because it affirms the systemic perspective and biopsychosocial model; that distress occurs systemically for military couples' and can be understood in terms of their biopsychosocial

and marital health. This research punctuates the need to better explore the biopsychosocial systems of dyads when assessing and designing treatment for military couples. Additionally, physiological assessments should be incorporated into systemic research since it is a response to biological, psychological, and social systems and an accessible and noninvasive measure. Below are clinical and research recommendations that further expand these points.

Clinical Recommendations

As evidenced by the results from this study, a systemic focus in military healthcare could benefit military personnel and their families. Instead of only treating an individual's needs and symptoms, such as a military personnel's PTSD or TBI, healthcare providers should consider how the individual's needs and symptoms impact the family system and shape treatment around the system rather than the individual. This can be achieved by implementing integrated care systems in military healthcare using systemic mental health providers, such as Medical Family Therapists, who are trained relationally but also recognize the biopsychosocial aspects of health. Integrated care consists of medical providers and on-site mental health providers working together to treat patients' biopsychosocial needs (Blount, 1998). Integrated care could be valuable to the military healthcare system because, in the civilian population, research has shown that patients are more likely to complete treatment when they are treated in an integrated care environment compared to being referred outside of the primary care center to receive mental health treatment (Katon, 1995). Implementing integrated care in military healthcare systems could have financial, operational, and clinical benefits by improving treatment outcomes for patients, allowing medical providers to address biological complaints without being overwhelmed by patients' psychosocial distress, and having mental health providers collaborate

with medical providers to attend to psychosocial issues affecting patients' health outcomes (Marlowe, Hodgson, Lamson, White, & Irons, 2012).

Spouses should be included in medical visits of military personnel because compliance with medical treatment has been associated with support from spouses (Rosland, Heisler, & Piette, 2012), and addressing psychosocial barriers to treatment could provide the opportunity for the couple to address their marital health, which would ultimately provide support to the spouse as well. Integrated care models in military healthcare would benefit military personnel and their families since findings from previous literature and the present study have shown that military personnel are facing a variety of biological, psychological, and social challenges that are interrelated and potentially impact the marriage and the family. Using integrated care to treat biopsychosocial health of military personnel, especially including relevant family in medical appointments when necessary, could have a systemic impact on the health of the military personnel's health, their marriage and their family.

Recommendations for Future Research

While several research recommendations could come from this study, one that is worth highlighting is the use of biofeedback as part of the biopsychosocial assessments used with military couples. SDNN is an appropriate and accessible measurement for Marriage and Family Therapy and Medical Family Therapy researchers to utilize, and it is valuable in capturing physiological distress. SDNN is commonly used in medical research (Acharya et al., 2006; Boysen et al., 2007; Licht et al., 2008; Tan et al., 2011; Smith et al., 2011), so incorporating it into biopsychosocial and marital research would provide further credibility and value to MFT and MedFT research among professionals from other fields. Previous medically-focused studies have found associations of SDNN with biological variables (Acharya et al., 2006; Boysen et al.,

2007), and the current study showed that SDNN can be used as a moderator in predictive relationships between psychosocial variables and marital adjustment. Ultimately, this means that physiological distress is an important component of understanding couples' biopsychosocial distress, and this relationship should be further explored in future research.

In the future, researchers also need to work toward studies that include interventions with military couples whereby both partners are included in the sample. Collaborative research efforts from biological and psychosocial fields could contribute to the development of systemic interventions to address biopsychosocial health for military couples as a dyad, and the efficacy of systemic interventions could be studied to determine how to better serve military personnel and their families. The findings from this thesis will hopefully contribute to future research, clinical models, policies, and resources that will enhance the biopsychosocial and marital health of military couples.

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APPENDIX A: PERMISSIONS TO USE MEASURES

Measure	Date Permission Granted for Overall Study (Lamson, 2011)	Date Permission Granted For Muse to Publish within Thesis and Journal article	Permission Granted From
Distress Thermometer	March, 2011	March 16, 2013	National Comprehensive Cancer Nework (NCCN)
PCL-C	March, 2011	March 17, 2013	Ariel Lang, PhD, MPH
PCL-M	Public Domain	Public Domain	Public Domain
Marital Adjustment Test	March, 2011	March 18, 2013	Wiley Online Library

APPENDIX B: IRB APPROVAL

EAST CAROLINA UNIVERSITY
University & Medical Center Institutional Review Board Office
1L-09 Brody Medical Sciences Building· Mail Stop 682
600 Moye Boulevard · Greenville, NC 27834
Office 252-744-2914 252-744-2914 · Fax 252-744-2284 ·
www.ecu.edu/irb

Notification of Continuing Review Approval

From:	Social/Behavioral IRB
To:	Angela Lamson
CC:	
Date:	4/5/2012
Re:	CR00000276 UMCIRB 11-0207 Integrated Care with Military Couples

I am pleased to inform you that at the convened meeting on 4/4/2012 of the Social/Behavioral IRB , this research study underwent a continuing review and the committee voted to approve the study. Approval of the study and the consent form(s) is for the period of 4/4/2012 to 4/3/2013.

The Social/Behavioral IRB deemed this study Greater than Minimal Risk.

Changes to this approved research may not be initiated without UMCIRB review except when necessary to eliminate an apparent immediate hazard to the participant. All unanticipated problems involving risks to participants and others must be promptly reported to the UMCIRB. The investigator must submit a continuing review/closure application to the UMCIRB prior to the date of study expiration. The investigator must adhere to all reporting requirements for this study.

The approval includes the following items:

Name	Description	Modified	Version
Informed Consent Form-Control Group	Consent Forms	11/4/2011 3:06 PM	0.01

Informed Consent Form-Experimental Group	Consent Forms	11/4/2011 3:06 PM	0.01
Informed Consent: Provider	Consent Forms	3/27/2012 1:34 PM	0.01
Military Questionnaire Packet	Surveys and Questionnaires	11/4/2011 2:15 PM	0.01
Military Questionnaire Packet	Interview/Focus Group Scripts/Questions	11/4/2011 2:15 PM	0.01
Military Questionnaire Packet	Other Medical Procedures/Considerations	11/4/2011 2:33 PM	0.01
Military Questionnaire Packet	Standardized/Non-Standardized Instruments/Measures	11/4/2011 2:11 PM	0.01
Recruitment Script	Recruitment Documents/Scripts	10/26/2011 11:16 AM	0.01
Timeline and Intervention Guide	Study Protocol or Grant Application	10/21/2011 3:14 PM	0.01
Updated processing form and other approved materials	Additional Items	3/27/2012 1:36 PM	0.01
Updated Recruitment Script	Recruitment Documents/Scripts	3/27/2012 1:32 PM	0.01

The following UMCIRB members were recused for reasons of potential for Conflict of Interest on this research study: None

The following UMCIRB members with a potential Conflict of Interest did not attend this IRB meeting: None

Note:

1. The Social/Behavioral IRB committee rated this study as greater than minimal risk because the interventions include motivational interviewing and solution focused questions (which exceed what would be part of a standard physical or psychological examination).

2. The Heart Rate Variability (HRV) is a sensor that poses no potential for physical harm.

IRB00000705 East Carolina U IRB #1 (Biomedical) IORG0000418
IRB00003781 East Carolina U IRB #2 (Behavioral/SS) IORG0000418 IRB00004973
East Carolina U IRB #4 (Behavioral/SS Summer) IORG0000418

From: Candia, Jessica CIV USAF AFMSA/SGE-C [mailto:Jessica.Candia@pentagon.af.mil]
Sent: Friday, August 19, 2011 12:33 PM
To: Lamson, Angela
Cc: Bartoe, Chelsea L Maj USAF ACC 4 FW/JA; James, Amy D Capt USAF ACC 4 MDOS/SGOW
Subject: Protocol FSG200110025H

Hello Ma'am,

My office has completed our review of the protocol FSG200110025H, "Integrated Care with Military Couples". Our human research protection compliance concerns have been resolved. Thus, we now concur with IRB approval of this activity. The activity can now begin, to the extent permitted by other applicable requirements.

Thank you for your assistance with this matter, and good luck with your research.

Sincerely,
Jessica

Jessica Candia, CIV, DAF
Program Manager
Research Oversight and Compliance Office
5201 Leesburg Pike, Suite 1501B
Falls Church, VA 22041
703-681-6311
jessica.candia@pentagon.af.mil

From: Odam, Kimberly L Ms CIV USA MEDCOM USAMRMC [mailto:Kimberly.Odam@us.army.mil]
Sent: Wednesday, May 23, 2012 12:52 PM
To: Lamson, Angela
Cc: Duchesneau, Caryn L Ms CIV USA MEDCOM USAMRMC; 'Ashley.Fisher@tatrc.org'; Jennings, Dawn V CIV USA MEDCOM USAMRAA; Brosch, Laura R Dr CIV USA MEDCOM USAMRMC; Bennett, Jodi H Ms CIV USA MEDCOM USAMRMC; Odam, Kimberly L Ms CIV USA MEDCOM USAMRMC; Katopol, Kristen R Ms CTR US USA MEDCOM USAMRMC; 'jeffrey.stephenson@tatrc.org'; Kitchen, Susan E Ms CTR US USA MEDCOM USAMRMC; Cistola, David
Subject: A-17093.1 HRPO Approval for the Protocol (Proposal Log Number 10251005, Award Number W81XWH-11-2-0221) (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

SUBJECT: Initial Approval for the Protocol, "Integrated Care With Military Couples," Submitted by Angela L. Lamson, PhD, East Carolina University, Greenville, North Carolina, in Support of the Proposal, "Operation Re-entry NC," Submitted by David P. Cistola, MD, East Carolina University, Greenville, North Carolina, Proposal Log Number 10251005, Award Number W81XWH-11-2-0221, HRPO Log Number A-17093.1

1. The subject protocol version 2 was approved by the East Carolina University (ECU) Institutional Review Board (IRB) on 15 May 2012. This protocol was reviewed by the U.S. Army Medical Research and Materiel Command (USAMRMC), Office of Research Protections (ORP), Human Research Protection Office (HRPO) and found to comply with applicable Department of Defense (DOD), U.S. Army, and USAMRMC human subjects protection requirements.

2. This greater than minimal risk study is approved for the accrual of 200 subjects.

3. The Principal Investigator has a duty and responsibility to foster open and honest communication with research subjects. The USAMRMC strongly encourages the Principal Investigator to provide subjects with a copy of the research protocol, if requested, with proprietary and personal information redacted as needed.

4. Please note that a Research Monitor (RM) is required to be involved in DOD-supported research studies that are determined to pose more than minimal risk to subjects (DOD Instruction 3216.02, Nov 2011). If the duties of the RM could require disclosure of subjects' Protected Health Information outside a covered entity (i.e., the RM is not an agent of the covered entity), your institution may require the identity and location of the RM to be described in the study Health Information Portability and Accountability Act authorization.

5. Please note the following reporting obligations. **Failure to comply could result in suspension of funding.**

a. Substantive modifications to the research protocol and any modifications that could potentially increase risk to subjects must be submitted to the HRPO for approval prior to implementation. The USAMRMC ORP HRPO defines a substantive modification as a change in Principal Investigator, change or addition of an institution, elimination or alteration of the consent process, change to the study population that has regulatory implications (e.g. adding children, adding active duty population, etc.), significant change in study design (i.e. would prompt additional scientific review), or a change that could potentially increase risks to subjects. All other amendments must be submitted with the continuing review report.

b. All unanticipated problems involving risk to subjects or others must be promptly reported by phone (301-619-2165), by email (HRPO@amedd.army.mil), or by facsimile (301-619-7803) to the HRPO. A complete written report will follow the initial notification. In addition to the methods above, the complete report can be sent to the U.S. Army Medical Research and Materiel Command, ATTN: MCMR-RP, 504 Scott Street, Fort Detrick, Maryland 21702-5012.

c. Suspensions, clinical holds (voluntary or involuntary), or terminations of this research by the IRB, the institution, the sponsor, or regulatory agencies will be promptly reported to the USAMRMC ORP HRPO.

d. A copy of the continuing review report and the re-approval notification by the ECU IRB must be submitted to the HRPO as soon as possible after receipt of approval. According to our records, it appears the current approval by the ECU IRB expires on 3 April 2013. Please note that the HRPO also conducts random audits at the time of continuing review and additional information and documentation may be requested at that time.

e. The final study report submitted to the ECU IRB, including a copy of any acknowledgement documentation and any supporting documents, must be submitted to the HRPO as soon as all documents become available.

f. The knowledge of any pending compliance inspection/visit by the Food and Drug Administration (FDA), Office for Human Research Protections, or other government agency concerning this research; the issuance of inspection reports, FDA Form 483, warning letters, or actions taken by any regulatory agencies including legal or medical actions; and any instances of serious or continuing noncompliance with the regulations or requirements must be reported immediately to the HRPO.

6. **Please note**: The USAMRMC ORP HRPO conducts random site visits as part of its responsibility for compliance oversight. Accurate and complete study records must be maintained and made available to representatives of the USAMRMC as a part of their responsibility to protect human subjects in research. Research records must be stored in a confidential manner so as to protect the confidentiality of subject information.

7. Do not construe this correspondence as approval for any contract funding. Only the Contracting Officer/Grants Officer can authorize expenditure of funds. It is recommended that you contact the appropriate contract specialist or contracting officer regarding the expenditure of funds for your project.

8. The HRPO point of contact for this study is Susan Kitchen, BS, Human Subjects Protection Scientist, at 301-619-1126 Susan.Kitchen@us.army.mil.

KIMBERLY L. ODAM, MS, CIP
Human Subjects Protection Scientist
Human Research Protection Office
Office of Research Protections
U.S. Army Medical Research and Materiel Command

Note: The official copy of this approval memo is housed with the protocol file at the Office of Research Protections, Human Research Protections Office, 504 Scott Street, Fort Detrick, MD 21702. Signed copies will be provided upon request.

Classification: UNCLASSIFIED
Caveats: NONE

APPENDIX C: MEASURES

Biological Health

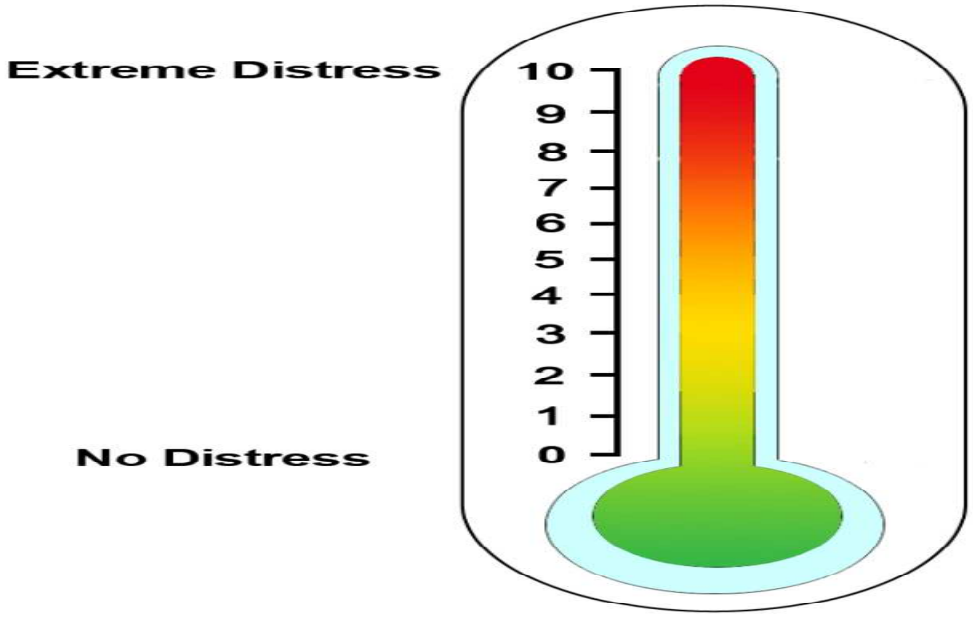
1. What is your Height?_____
2. What is your Weight?_____
3. What is your BMI?_____
4. What is your blood pressure?_____/_____
5. What is your average HRV?_____

*This section will be completed by researcher

Psychological Health

Distress Thermometer

To be completed by the Participant
First please circle the number (0-10) that best describes how much distress you have been experiencing in the past week including today.



Please read the list below. Have any of the following problems been a cause of your distress in the past week, including today? Be sure to check NO or YES for each.

Practical Problems			**Physical Problems**		
		Housing			Pain
		Insurance/financial			Nausea
		Work/school			Fatigue (feeling tired)
		Transportation			Sleep
		Child care			Getting around
					Bathing/dressing
Family Problems					Breathing
		Dealing with partner			Mouth sores
		Dealing with children			Eating
					Indigestion
Emotional Problems					Constipation
		Worry			Diarrhea
		Fears			Changes in urination
		Sadness			Fevers
		Depression			Skin dry/itchy
		Nervousness			Nose dry/congested
					Tingling in hands/feet
		Spiritual/religious concerns			Feeling swollen
		Loss of interest in usual activities			Memory or concentration
					Appearance
					Sexual

Other problems:

_____

_____

_____

PTSD Checklist – Military Version (PCL-M)

Instructions: Below is a list of problems and complaints that veterans sometimes have in response to a stressful military experience. Please read each one carefully, put an "X" in the box.

		Not at all	A little bit	Moderately	Quite a bit	Extremely
1.	Repeated, disturbing *memories, thoughts, or images* of a stressful military experience?					
2.	Repeated, disturbing *dreams* of a stressful military experience?					
3.	Suddenly *acting* or *feeling* as if a stressful military experience *were happening again* (as if you were reliving it)?					
4.	Feeling *very upset* when *something reminded* you of a stressful military experience?					
5.	Having *physical reactions* (e.g., heart pounding, trouble breathing, or sweating) when *something reminded* you of a stressful military experience?					
6.	Avoid *thinking about* or *talking about* a stressful military experience or avoid *having feelings* related to it?					
7.	Avoid *activities* or *talking about* a stressful military experience or avoid *having feelings* related to it?					
8.	Trouble *remembering important parts* of a stressful military experience?					
9.	Loss of *interest* in things that you used to enjoy?					
10.	Feeling *distant* or *cut off* from other people?					
11.	Feeling *emotionally numb* or being unable to have loving feelings for those close to you?					
12.	Feeling as if your *future* will somehow be *cut short*?					
13.	Trouble *falling* or *staying* asleep?					
14.	Feeling *irritable* or having *angry outbursts*?					
15.	Having *difficulty* concentrating?					
16.	Being "*super alert*" or watchful on guard?					
17.	Feeling *jumpy* or easily startled?					

Has anyone indicated that you've changed since the stressful military experience? Yes __ No__

PTSD Checklist – Civilian Version (PCL-C)

Instruction to patient: Below is a list of problems and complaints that veterans sometimes have in response to stressful life experiences. Please read each one carefully, put an "X" in the box to indicate how much you have been bothered by that problem *in the last month*.

No.	Response	Not at all (1)	A little bit (2)	Moderately (3)	Quite a bit (4)	Extremely (5)
1.	Repeated, disturbing *memories, thoughts, or images* of a stressful experience from the past?					
2.	Repeated, disturbing *dreams* of a stressful experience from the past?					
3.	Suddenly *acting* or *feeling* as if a stressful experience *were happening* again (as if you were reliving it)?					
4.	Feeling *very upset* when *something reminded* you of a stressful experience from the past?					
5.	Having *physical reactions* (e.g., heart pounding, trouble breathing, or sweating) when *something reminded* you of a stressful experience from the past?					
6.	Avoid *thinking about* or *talking about* a stressful experience from the past or avoid *having feelings* related to it?					
7.	Avoid *activities* or *situations* because they *remind you* of a stressful experience from the past?					
8.	Trouble *remembering important parts* of a stressful experience from the past?					
9.	Loss of *interest in things that you used to enjoy?*					
10.	Feeling *distant* or *cut* off from other people?					
11.	Feeling *emotionally numb* or being unable to have loving feelings for those close to you?					
12.	Feeling as if your *future* will somehow be *cut short*?					
13.	Trouble *falling* or *staying asleep*?					
14.	Feeling *irritable* or having *angry outbursts*?					
15.	Having *difficulty concentrating*?					
16.	Being *"super alert"* or watchful on guard?					
17.	Feeling *jumpy* or easily startled?					

Relational Measure

Marital Adjustment Test

1. Circle the dot on the scale below which best describes the degree of happiness, everything considered, of your present marriage. The middle point, "happy," represents the degree of happiness which most people get from, marriage, and the scale gradually ranges on one side to those few people who are very unhappy in marriage, and on the other, to those few who experience extreme joy or felicity in marriage.

Very Unhappy **Happy** **Perfectly Happy**

State the approximate extent of agreement or disagreement between you and your mate on the following items. Please check each column.

	Always Agree	Almost always Agree	Occasionally Disagree	Frequently Disagree	Almost always Disagree	Always Disagree
2. Handling family finances						
3. Matters of recreation						
4. Demonstration of affection						
5. Friends						
6. Sex relations						
7. Conventionality (right, good, or proper conduct)						
8. Philosophy of life						
9. Ways of dealing with in-laws						

10. When disagreements arise, they usually result in:
(a) husband giving in (b) wife giving in (c) agreement by mutual give and take

11. Do you and your mate engage in outside interests together?
(a) All of them (b) some of them (c) very few of them (d) none of them

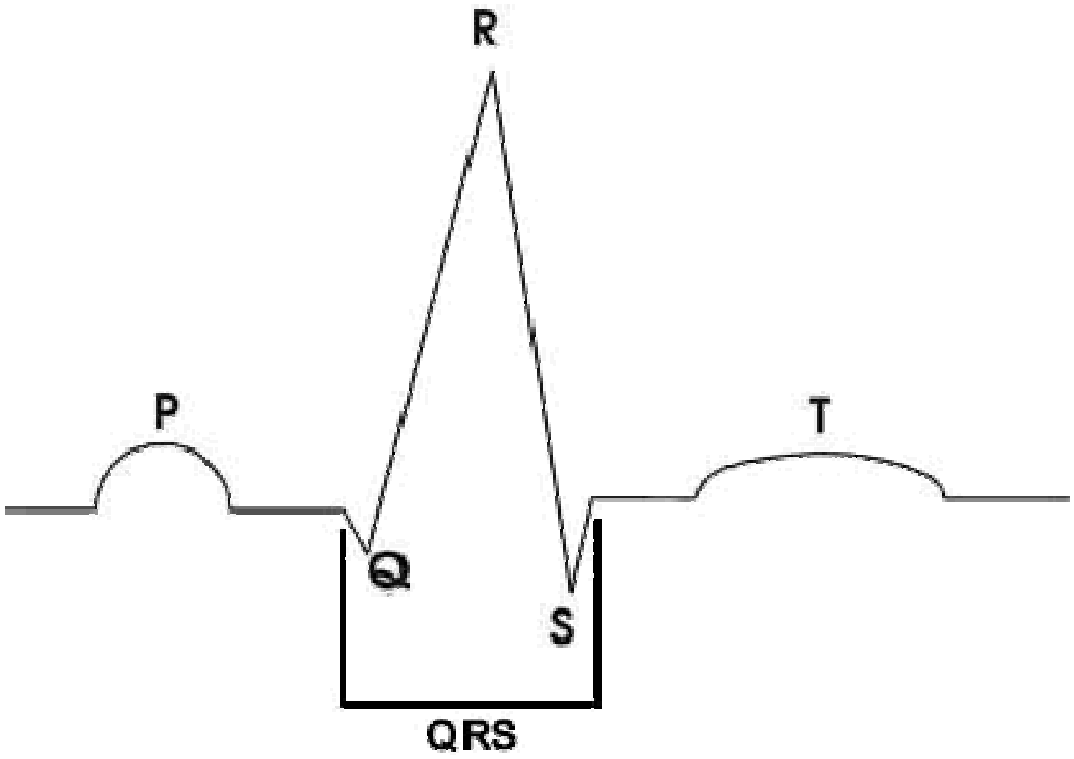
12. In leisure time do you generally prefer:
(a) to be "on the go" (b) to stay at home

Does your mate generally prefer:
(a) to be "on the go" - (b) to stay at home
13. Do you ever wish you had not married?
(a) Frequently (b) Occasionally (c) rarely (d) never

14. If you had your life to live over again, do you think you would:
(a) Many the same person (b) Marry a different person (c) Not marry at all

15.Do you ever confide in your mate:
(a) almost never (b) rarely (c) in most things (d) in everything

APPENDIX D: HEART RATE VARIABILITY



SDNN is the standard deviation of normal-to-normal QRS intervals.