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The Effect Of Combat Exercises On Cardiovascular Response: An Exploratory Study

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THE EFFECT OF COMBAT EXERCISES ON CARDIOVASCULAR RESPONSE: AN EXPLORATORY STUDY

by

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ABSTRACT

Cardiovascular disease is the leading cause of death in the United States and accounts for two-thirds of deaths globally. Of the many disorders that fall under this umbrella, hypertension (HTN) is the most significant, for it plays a major role in many other disorders. Affecting one in every three adults, this silent killer has emerged in an unsuspecting population: young soldiers. With the rapid succession of multiple deployments, long intervals between blood pressure (BP) assessments, and the absence of cardiovascular (CV) measures during the pre and postdeployment health screenings, soldiers may be at higher risk for HTN than their civilian counterparts of the same age. Although studies have addressed the relationship between deployment and HTN, most were retrospective, often using older soldiers, single BP measures, and self-reported information extracted from questionnaires and databases. The purpose of this study was to explore the cardiovascular response of soldiers before, during, and after exposure to simulated combat stressors as well as to assess the personal characteristics that may influence cardiovascular response.

Applying the Allostasis/Allostatic Load theoretical framework as a guide, a repeated measure quasi experimental design compared the CV measures of two identical groups: one exposed to 3-4 hours of strenuous paintball (physical stressor), and the other exposed to a land navigation exercise (psychological stressor) and 45 minutes of a paintball weapon familiarization exercise. A sample of 60 Army Reserve Officer Training Corps cadets were fitted with Tiba Medical Ambulo 2400 ambulatory BP monitors for 48 continuous hours to assess their CV response before, during, and after exposure to the simulated combat stressors. Cardiovascular indices known to be predictors of future HTN (e.g., systolic blood pressure [SBP] variability,

cardiovascular recovery, morning BP surge, and evening BP decline) were collected. Four instruments (e.g., Participant Information Sheet, State-Trait Anxiety Inventory, Paintball Perceived Stress Questionnaire, and Army Physical Fitness Test) were then used to collect information to conduct bivariate correlations to assess which factors (individual differences, anxiety/perceived stress, and level of fitness) played the most significant role.

Group A (n = 30), the experimental group exposed to the physical stressor, had a mean age of 21.57 years while Group B (n = 30), the control group exposed to the psychological stressor, had a mean age 20.57 years. Independent sample *t*-tests found no significant differences (p > .05) between the groups' demographic characteristics with the exception of deployment history (experimental = 4, control = 0).

One-way ANOVAs, paired sample *t*-tests, and independent sample *t*-tests were used to compare the BP and pulse rates (PR) of both groups before, during, and after the stressors. Of all the measures taken during the three intervals, the only significant finding (p= <.05) was the poststressor systolic blood pressure (SBP). The experimental group had a higher mean waking SBP after the stressor when compared to the control group (113.76 mm Hg vs. 102.98 mm Hg) as well as a higher waking mean arterial pressure (MAP) (85.22 vs. 77.43).

Using a paired sample *t*-test, pre and poststressor morning BP surges were compared, with significant findings (p < .05): In the control group, the SBP surge difference was 9.14 mm Hg, and in the experimental group, it was only 5.93 mm Hg. Diastolic blood pressure (DPB) morning surges demonstrated the same pattern, with the control group having a 9.31 mm Hg difference and the experimental group having only a 2.95 mm Hg difference. For evening BP decline, a significant difference was found only in the SBP, with the control group once again having a greater difference (12.95 mm Hg vs. 3.95 mm Hg) than the experimental group. For poststressor SBP recovery, although the control group had a greater SBP decline (21.50 mm Hg vs. 10.93 mm Hg), these findings were not statistically significant.

Bivariate correlations were conducted using Pearson and Spearman rho correlation coefficients, which found many weak but statistically significant correlations ($p = < .05$) during the intervals.

Female gender positively correlated with elevated PR during all intervals. Age positively correlated with elevated BP during the stressor and increased morning BP surge poststressor. Regarding race, there was a negative correlation between Caucasians and prestressor sleeping BP; however, in African-Americans, this correlation was positive. African-Americans also had decreased SBP recovery after the stressor and minimal DBP morning surge prestressor, whereas Caucasians had increased DBP during the stressor. Those of Hispanic descent had elevated PR during and after the stressor but had no significant BP findings. Waist circumference positively correlated with elevated BP morning surge prestressor; however, body mass index (BMI) positively correlated with elevated BP morning surge poststressor. During the stressor, both waist circumference and BMI positively correlated with elevated SBP and DBP, with waist circumference having the stronger correlation and BMI only correlating with elevated PR. Family history of HTN only correlated with greater prestressor SBP decline, whereas deployment history correlated with mean waking SBP and MAP.

Trait anxiety scores negatively correlated with SBP recovery after the stressor. State anxiety scores, however, positively correlated with poststressor waking MAP and evening SPB decline, which influenced the negative correlation found between state anxiety and poststressor sleeping SBP. As for perceived stress, there were only two significant findings: The level of perceived stress after the stressor negatively correlated with prestressor waking SBP, and the level of perceived stress during the stressor negatively correlated with poststressor SBP morning surge.

Army Physical Fitness (APFT) total scores as well as APFT run scores negatively correlated with pre and poststressor pulse rates. Although level of fitness did not correlate with BP directly, it did negatively correlate with waist circumference.

These findings show that age, female gender, African-American descent, waist circumference, BMI, previous deployment history, level of fitness, and psychological stress state during and after a stressor were more strongly associated with soldiers' CV response. These findings also showed that the psychological stress associated with performing a combat task alone, although not physically challenging, was enough to elicit a stress response comparable to an intense physical stressor. If a strenuous combat exercise using paintball was enough of a stressor to produce a residual effect that lasted well into following morning, the residual effect of a lengthy, strenuous deployment may be alarming. This study not only provides a snapshot of the cardiovascular health of incoming young soldiers, but also provides rich quantitative evidence to support policy change regarding the need for implementing CV health assessments during the pre-, post-, and six- month postdeployment health screenings.

This dissertation is dedicated to the soldiers, marines, airmen, and sailors, past and present, who put their lives on the line every day while many others sleep soundly. It takes a very special person to put on the uniform, leave the comfort and security of their home and family, and willingly be placed in dangerous situations with no guarantee of survival. May your courage, sacrifice, and fighting spirit never be forgotten!

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CHAPTER ONE: THE PROBLEM

Specific Aims

Cardiovascular disease is the leading cause of death in the United States (U.S.) and accounts for one-third of the deaths globally (Mensah & Brown, 2007; World Health Organization [WHO], 2003). Of the many disorders that fall under the umbrella of cardiovascular disease, hypertension is the most significant for it plays a major role in many other cardiovascular diseases (Rosamond, Flegal, Furie, Go, Greenlund, Haase, et al., 2008). Hypertension is responsible for 62% of all strokes and 49% of all cases of heart disease, and is the strongest predictor for arteriosclerosis (Redwood, 2007). In the U.S., approximately 72 million people, or one in every three adults, have hypertension (Rosamond et al., 2008). Despite access to health education related to hypertension and ready access to public blood pressure screenings, approximately 30% of the adults in the U.S. diagnosed with hypertension were unaware that they even had it (U.S. Department of Health and Human Services [USDH&HS], 2004). Of those who were aware, 40% of them still went untreated (USDH&HS, 2004).

Although the military is comprised of a younger cohort of individuals than the general population, there is a growing concern over the presence of hypertension risk factors among its soldiers (Smoley, Smith & Runkle, 2008). Military studies have shown that risk factors such as high body mass index (BMI) and tobacco use have been major contributors to poor cardiovascular health (McGraw, Turner, Stotts & Dracup, 2008). When a repeated and prolonged stressor such as military deployment is added, exposure over time may cause functional (e.g., blood pressure that does not drop at least 10% when asleep) and structural (e.g., left ventricular hypertrophy) changes in the cardiovascular system (McEwen, 1998). At closer glance, military deployment, in essence, is a compilation of several hypertension risk factors (e.g., repeated exposure to a stressor, lack of quality sleep, high salt/ low potassium diets, etc.). Furthermore, although blood pressure is checked once a year during a soldier's mandatory Periodic Health Assessment, there is the possibility that his/her blood pressure may go unchecked if he/she is deployed during the health assessment window. Studies have linked combat exposure to increased risk for hypertension; however, many of those studies were based on older soldiers, information extracted from databases or self-reported questionnaires, and/or single blood pressure measures. What is not known is the actual continuous cardiovascular response that occurs before, during, and after combat exposure, which may show a distinct pattern in someone at higher risk. Since hypertension has no symptoms and is not consistently assessed during the pre and postdeployment health screenings, it may result in many secondary disease processes that could have been prevented with proper blood pressure control. This potential also increases the burden on the Veteran Affairs Medical Centers who provide long-term care for veterans.

Purpose

The purpose of this research study was to assess the cardiovascular response that occurs before, during, and after exposure to a combat-related stressor, as well as to assess the personal characteristics that play the most significant role in the soldier's cardiovascular response.

Research Questions

The following research questions will be addressed:

1. What is the cardiovascular response of a soldier under a simulated combat stressor:
    a. When comparing systolic blood pressures (before, during, and after the stressor)?
    b. When comparing diastolic blood pressures (before, during, and after the stressor)?
    c. When comparing mean arterial pressures (before, during, and after the stressor)?

d. When assessing the number of mm Hg the systolic blood pressure declined after the stressor ceased?
e. When comparing pre and poststressor morning blood pressure surges?
f. When comparing pre and poststressor evening blood pressure declines?

2. What factors (individual differences, anxiety/perceived stress, or level of fitness) play the most significant role in a soldier's cardiovascular response under a simulated combat stressor)?

This study served as the preliminary study for a two-phase program of research that addressed two questions:

- Phase I: Do soldiers who have shown a significant cardiovascular response during a sustained combat stressor develop hypertension? If so, which factors (individual differences, anxiety/perceived stress, health behaviors, or deployment history) play the most significant role?
- Phase II: When placed under a sustained combat stressor, is there a difference between the cardiovascular response of a soldier with an extensive deployment history and a soldier with minimal deployment history (e.g., which is more detrimental to cardiovascular health: Shorter, more frequent deployments or longer, less frequent deployments?)?

Definition of Terms

Several terms are used throughout this study. Conceptual and operational definitions are presented in Table 1.

Table 1. Definition of Terms

Term	Conceptual	Operational
1. Simulated Combat	The reproduction of an orchestrated struggle between opposing individuals or forces in a military setting (Merriam-Webster, 2003).	Participation in a six-scenario paintball exercise.
2. Stress	The non-specific response of the body to any demand made upon it. (Selye, 1974).	Any changes in cardiovascular response (as measured by the Tiba Medical Ambulo 2400 ambulatory blood pressure monitor) secondary to an external combat-related stimulus.
3. Cardiovascular Response	The magnitude of cardiovascular changes that occur during and/or after exposure to a stressor. Mathematically, this is depicted as "measure stressor period (minus) measure prestressor period" (Cacioppi, 2007).	The difference between the prestressor, during stressor, and poststressor cardiovascular measures as measured by the Tiba Medical Ambulo 2400 ambulatory blood pressure monitor. See individual measures below (a – f).
a. Systolic Blood Pressure	The pressure exerted against the wall of the artery during the contraction of the left ventricle (National Heart Lung and Blood Institute, 2009).	The average systolic blood pressure.
b. Diastolic Blood Pressure	The pressure exerted against the wall of the artery during the relaxation of the left ventricle (National Heart Lung and Blood Institute, 2009).	The average diastolic blood pressure.
c. Mean Arterial Pressure	The average pressure within the artery over a complete cardiac cycle. (2/3 [times] diastolic pressure [plus] 1/3 [times] systolic pressure) (Guyton et al., 2006)	The average mean arterial pressure.
d. Morning Blood Pressure Surge	The difference between the mean systolic blood pressure during the two hours after rising (minus) the mean systolic blood pressure during sleeping hours (Kaplan, 2003).	The mm Hg that the blood pressure increases during the first two hours after rising.

Term	Conceptual	Operational
e. Evening Blood Pressure Decline	The percentage that the blood pressure declines when comparing mean waking blood pressure to mean sleeping blood pressure (Sayk et al., 2007).	The percentage that the blood pressure declines when comparing the mean waking blood pressure to the mean sleeping blood pressure.
f. Cardiovascular Recovery	The extent to which the elevated blood pressure and/or pulse rate persists after a stressor has ceased over a given amount of time (Trivedi et al., 2007 & Steptoe et al., 2005).	The mm Hg that the blood pressure (systolic, diastolic, mean) decreases one hour after the cessation of the stressor.
4. Individual Differences	Characteristics that cannot be controlled or changed (Rosamond et al., 2008).	The participant's age, gender, race, ethnicity, and family history of hypertension as measured by the self-reported Participant Information Sheet.
5. Level of Fitness	The ability level to respond to a physical demand with enough reserve energy to cope with a sudden challenge. This is based on five factors (cardiorespiratory endurance, muscular strength, muscular endurance, flexibility, and body composition) (Hales, 2009).	The highest total score received on the Army Physical Fitness Test within the last three months.
6. Anxiety	The unpleasant state or condition that is induced by stress (Speilberger, 1993).	Total score received on the State and Trait Anxiety Inventory questionnaires.
7. Perceived Stress	One's view of how challenging a stressor is (Hales, 2009).	Score received on each question of the Paintball Exercise Questionnaire.

Assumptions

1. A simulated combat exercise lasting two to four hours will be enough of a stressor to elicit a significant cardiovascular response.
2. The instruments used will provide accurate data.

3. Participants will wear the blood pressure monitor during the data collection points.
4. Participants will be truthful in their responses to the questionnaire items.

Significance

This research study provided rich quantitative evidence on the cardiovascular health of a population that would not normally be assessed for high cardiovascular risk. The short-term goal of this study was to assess if the stressors of combat have a negative effect on cardiovascular health. The long -term goal of this study is to provide evidence to support policy change to incorporate cardiovascular assessments during the pre, post, and six-month postdeployment health screenings. This study is important because hypertension is asymptomatic and is often diagnosed during health care visits for other health reasons. Soldiers who participate in rapid successive deployments may be overlooked for asymptomatic diseases such as hypertension, and have the added stress of deployment on top of preexisting risk factors. By studying cardiovascular response early, those at higher risk can be identified and preventive measures can be instituted without interrupting the unit's combat mission. Today's soldiers are tomorrow's veterans, and since Veteran Affairs medical treatment facilities are already providing care for veterans of five different wars, chronic health problems such as hypertension will further burden this already overtaxed system. Preventive measures taken today will greatly impact military health expenditures, tax payer dollars, and quality of life for tomorrow's veterans.

Summary

This chapter discussed the specific aims, purpose, terms, and significance of conducting cardiovascular studies in a young military population. Although hypertension is usually associated with the older population, the rapid succession of deployments, prolonged exposure to stress, and lack of cardiovascular health assessments during the pre and postdeployment health screenings may put soldiers at higher risk for this chronic but asymptomatic disease.

CHAPTER TWO: REVIEW OF RELEVANT LITERATURE AND THEORETICAL FRAMEWORK

Background and Significance

This chapter describes the background, research, and theoretical framework supporting the relationship between stress and hypertension and the increased risk in young soldiers. This chapter also summarizes past research as well as the current need for hypertension studies in a military population.

Review of Literature

A review of literature was conducted using the CINAHL, Cochrane Database of Systematic Review, MEDLINE, Google Scholar, PsycARTICLES, and PsycINFO databases, along with governmental and military publications. The keywords used include *military, deployment, stress, cardiovascular response, hypertension*, and *cardiovascular disease*.

Hypertension: Definition and Prevalence

Hypertension, also known as high blood pressure, is defined as a systolic blood pressure of 140 mmHg or higher, or a diastolic blood pressure of 90 mmHg or higher on at least two separate occasions as measured by a health care professional (Rosamond et al, 2008). Within the last few years, the classification of blood pressure has changed. A normal blood pressure is defined as a systolic pressure of <120 mm Hg or a diastolic pressure of < 80 mm Hg (USDH&HS, 2004). Pre-hypertension, the newest category of high blood pressure, is defined as a systolic pressure between 120-139 mm Hg or a diastolic pressure between 80-89 mm Hg (USDH&HS, 2004). This category was identified to focus treatment towards adopting healthpromoting lifestyle changes before there is a need for medication (Lenfant, Chobanian, Jones, & Roccella, 2003).

The category of hypertension is divided into two stages. Stage 1 hypertension is a systolic pressure between 140-159 mm Hg or diastolic pressure of 90-99 mm Hg. Stage 2 is a systolic pressure >160 mm Hg or a diastolic pressure >100 mm Hg (USDH&HS, 2004). Ninety percent of hypertension cases are considered "essential hypertension," which is a high blood pressure due to unknown causes (Oparil, Zaman & Calhoun, 2003). The remaining 10% of cases have been attributed to sleep apnea, chronic kidney disease, primary aldosteronism, Cushing's syndrome, steroid therapy, thyroid/parathyroid disease, pheochromocytoma, or coarctation of aorta (USDH&HS, 2004).

Approximately 72 million people in the United States (U.S.), or one in every three adults, has hypertension (USDH&HS, 2004). Between 2001 and 2002, 45 million people visited hospitals and clinics with health conditions relating to hypertension (Rosamond et al., 2008). For example, in Florida, approximately 143,500 people were discharged with cardiovascular-related conditions, costing the state approximately $7.6 billion dollars in pharmaceuticals and post-hospitalization care (Florida Department of Health, 2007). Nationally, it was estimated that 164 million work days were lost in 2006 due to three chronic conditions-- hypertension among them--which cost employers approximately $30 billion (Brookes, 2007). In 2010 it is estimated that $76.6 billion will be spent on direct and indirect costs relating to hypertension (Lloyd-Jones, Adams, Brown, Carnethon, Dai, DeSimone et al., 2010). Often unnoticed until the blood pressure is at a dangerously high level, this progressive disease is the gateway to many other, often fatal health consequences such as impaired vision, cerebrovascular disease, ischemic heart disease, left ventricular hypertrophy, and renal failure (Rosamond et al., 2008). Hypertension has been seen in 52% of those with dyslipidemia, 74% of those with diabetes, and 81% of those with chronic renal disease (Stiles, 2007). Hypertension is highly prevalent in industrialized countries but has become more common worldwide due to increased longevity, physical inactivity, and unhealthy eating habits (WHO, 2003). Although the death rate in the U.S. due to cardiovascular disease decreased 42% from 1980 to 2000, the decrease was attributed to secondary and tertiary advances in medicine rather than to primary prevention (Florida Department of Health, 2002). Despite advances in diagnosis and treatment, researchers predict that the prevalence of hypertension will increase from 26.4% to 29.2% by the year 2025 (Ong, Tso, Lam, & Cheung, 2008).

Although a preventable disease, hypertension was responsible for 57,077 deaths in 2007, or 17.5 per every 100,000 persons (Lloyd-Jones et al., 2010). Risk factors such as poor diet (high salt, high fat, low potassium, and excessive alcohol consumption), tobacco use, psychosocial stressor, sleep apnea, increased weight, low education, low socioeconomic status, and family history have all been associated with the disease (Lloyd-Jones et al., 2010). In regard to race, African-Americans are among the most at-risk in the world, with African-American women being the most predominate (Lloyd-Jones et al., 2010). When compared to Caucasians, African-Americans have higher mean blood pressures and develop hypertension earlier in life (Lloyd-Jones et al., 2010). In regard to gender, hypertension is more prevalent in men than women until the age of 45 (Lloyd-Jones et al., 2010). Between the ages of 45 to 64 both genders are similar; however, by age 65 the prevalence is much higher in females.

Hypertension in a Young, Presumably Healthy Population

In the past, hypertension was considered to be a disease of the elderly. However, over the last several years there has been a growing concern of hypertension occurring among the young. Studies have shown that family history, BMI, and psychosocial stressors are three of the most significant factors when considering cardiovascular risk in the young (Izzo, Sica & Black, 2008).

A longitudinal study following 315 school-age children in Tennessee showed that students who had at least one parent with a history of hypertension had a higher systolic cardiovascular response when exposed to a stressor (change of 17.2 mm Hg versus 14.9 mm Hg, $p = .01$) (Li, Alpert, Walker & Somes, 2007). It was also found that students with a parental history of hypertension had significantly higher BMIs when compared to students with no parental history of hypertension (21.6 versus 19.9, $p = .01$) (Li et al., 2007). In another study addressing family history's role in blood pressure, 48 African-American adolescents were exposed to cold pressor tests to assess blood pressure and cortisol reactivity. Although there was no significant difference between those with a family history of hypertension and those without in regard to cortisol reactivity ($F = .389$, $p = .844$), those with a family history of hypertension demonstrated significant cardiovascular reactivity ($\chi^2 = 8.813$, $p = .004$) (Covelli, 2006). This family history connection could be attributed genetics; however, living in a shared environment should also be considered (Izzo et al., 2008).

In regards to BMI and its relationship to hypertension, a study was conducted among the athletic players of the National Football League (NFL) (Tucker, Vogel, Lincoln, Dunn, Ahrensfield, Allen, et al., 2009). When a cross-sectional analysis of 504 active and veteran NFL players were compared to men in the general population of the same age group, 65% ([$n = 310$] 95% CI, 58.3%-70.7%) of the NFL players versus only 24.2% ([$n = 473$] 95% CI, 22.3%-26.1%)

of the general population were classified as pre-hypertensive ($p < .001$). As for hypertension, 13.8% ([*n* = 67] 95% CI, 11%-16.7%) of the NFL sample versus 5.5% ([*n* = 108] 95% CI, 4.6%-6.6%) of the general population were identified ($p < .001$) (Tucker et al., 2009). In both categories, high BMI was associated with higher blood pressure among the NFL players, even though they had a high level of fitness (see Table 2) (Tucker et al., 2009).

Table 2. Prevalence of Cardiovascular Risk Factors among NFL Players

	Offense Lineman (n = 109)	Defense Lineman (n = 85)	Tight End/ (n = 37)	Line-backer (n = 63)	Running Back (n = 47)	Quarter-back (n = 24)	Kicker (n = 20)	Wide Receiver (n = 48)	Defense Back (n = 71)	*P* Value
BMI ≥ 30	109 (100.0) [96.6-100.0]	80 (94.1) [87.0-97.5]	28 (75.7) [59.9-86.6]	45 (71.4) [59.3-81.1]	34 (72.3) [58.2-83.1]	1 (4.2) [0.7-20.2]	2 (10.0) [2.8-30.1]	0 (0) [0-7.4]	2 (2.8) [0.8-9.7]	<.001
Pre HTN	70 (66.7) [57.2-75.0]	51 (63.0) [52.1-72.7]	24 (68.6) [52.0-81.4]	35 (58.3) [45.7-69.9]	28 (62.2) [47.6-74.9]	14 (60.9) [40.8-77.8]	13 (68.4) [46.0-84.6]	29 (61.7) [47.4-74.2]	41 (62.1) [50.1-72.9]	.98
HTN	26 (24.8) [17.5-33.8]	12 (14.8) [8.7-24.1]	4 (11.4) [4.5-26.0]	7 (11.7) [5.8-22.2]	5 (11.1) [4.8-23.5]	4 (17.4) [7.0-37.1]	2 (10.5) [2.9-31.4]	4 (8.5) [3.4-19.9]	7 (10.6) [5.2-20.3]	.21

Tucker, et al., 2009

Finally, several chronic psychosocial stressors have been studied regarding stress and cardiovascular response. A meta analysis of studies conducted over 30 years showed that job stress, general life stressors, depression, anxiety, Type-A behavior, and burnout were some of the key chronic psychosocial factors affecting cardiovascular response in a healthy population (Chida & Hamer, 2008). Job stress, which can be a result or a factor of the others, may be the most significant. In a study assessing the relationship between job stress and hypertension in young working adults, men with high-strain jobs showed a greater cardiovascular response throughout their work day (Light, Turner & Hinderliter, 1992). Using a repeated measures approach, 129 healthy normotensive men and women were monitored continuously throughout their work day. Men who classified themselves has having high-strain jobs showed greater cardiovascular response (SBP: + 9.9 mm Hg versus 3.4 mm Hg, and DBP: +7.9 mm Hg versus 3.1.mm Hg, p <.03) when compared to the other adults (Light et al., 1992).

Hypertension in a Military Population

The military is made up of a younger cohort of individuals; however, members of the Armed Forces are not free from cardiovascular disease (Fisher & Nichol, 2005). Between 1996 and 1999, 39% of the 215 exercise-related deaths of active duty Army personnel were attributed to cardiovascular health issues (McGraw et al., 2008). Just as in the general population studies, family history, high BMI, and stress may be the most significant contributors to hypertension risk in a young military population.

Since many conditions are more frequently found in high-risk military occupations, researchers emphasize the importance of thoroughly assessing all individuals for cardiac conditions immediately and correctly, given that they can be easily overlooked during the rapid pre and postdeployment process (Fisher et al., 2005). Although severe hypertension is a disqualifying factor for entry into the Armed Forces, and uncontrolled complicated hypertension can be the basis for separation, a recent study of 15,106 soldiers stationed in the northwestern U.S. found that 63% were pre-hypertensive (Smoley et al., 2008). Using the Health Risk Appraisal questionnaire and health records, researchers found that increased age (OR 1.04, 95% CI 1.04-1.05), BMI (OR 1.13, 95% CI 1.12-1.15), male sex (OR 1.96, 95% CI 1.61-2.39), African ancestry (OR 1.52, 95% CI 1.31-1.75), and higher rank (OR 1.23, 95% CI 1.09-1.39) were closely associated with the high prevalence of hypertension (Smoley et al., 2008).

Most past studies related to hypertension in the military assessed an older population of soldiers, usually from the Vietnam and Gulf War era, as well as information taken from databases and self-reported questionnaires. In a cross-section prevalence study of veterans at a Veteran's Administration hospital, researchers performed a 10-year post-1991 Gulf War assessment using the Short Form-36 (Eisen, Kang, Murphy, Blanchard, Reda, Henderson et al, 2005). Analysis of data from both deployed (*n* 1,061) and non-deployed (*n* 1,128) veterans found that 13.6% of the deployed veterans became hypertensive (OR 1.18, 95% CI 0.90–1.54) compared to only 7.9% of the non-deployed veterans (OR 0.99, 95% CI 0.75–1.30) (Eisen, et al, 2005).

Another study of military personnel assessed the prevalence of hypertension among three groups of Navy Seabees:

1. Those who deployed to the Gulf (*n* 3,831)
2. Those who deployed elsewhere (*n* 4,933)
3. Those who did not deploy (*n* 3,104) (Gray, Reed, Kaiser, Smith, & Gastanaga, 2002).

A series of questionnaires were mailed at five-month intervals to these soldiers. When comparing Gulf War Seabees to those who deployed elsewhere (OR 1.63, 95% CI 1.36-1.95) and Gulf War Seabees to those who did not deploy (OR 1.82, 95% CI 1.48-2.26), 8% of the Gulf War Seabees, 5% of the Seabees who deployed elsewhere, and 5% of the non-deployed Seabees self-reported the presence of hypertension (Gray, et al, 2002). The strength of this study was the available sample size as well as the ability to compare two different types of deployment environments. However, a limitation to this study was that the information was self-reported.

A similar study assessed the incidence of hypertension eight years after deployment in a sample of veterans who deployed to Iraq (*n* 1263), veterans who deployed to Southwest Asia (*n* 610), and a group of non-deployed veterans (*n* 516) (McCauley, Lasarev, Sticker, Rischitelli, & Spencer, 2002). A higher incidence of hypertension was found among those veterans who deployed (OR 1.7, 95% CI 1.3-2.4) (McCauley et al., 2002).

Finally, a recent study compared military and civilian cohorts for cardiovascular risk factors such as age, gender, hypertension, dyslipidemia, smoking, obesity, glucose abnormality/insulin resistance, and stress, and found that hypertension and smoking were more prevalent in the military population than in the civilian population (hypertension 12.1% versus 7.2% and smoking 32.2% versus 21.6%, respectively) (McGraw et al., 2008).

During the proceedings at the 42nd Annual Society of Epidemiology Research meeting, researchers reported a high prevalence of "new-onset" hypertension among soldiers that had recently deployed. This ongoing study, known as the Millennium Cohort Study, has been analyzing deployment health data since 2001. By comparing baseline data (July 2001 to June 2003) of U.S. military services members (*n* 77,047) and follow-up data (July 2004 to February 2006) on 55,021 participants, it was found that those who deployed with combat exposure were

1.28 times more likely to develop hypertension than those who did not (95% CI, 1.04-1.58) (Granado, Smith, Swanson, Harris, Shahar, Smith et al, 2009). Those with a higher BMI were twice as likely to become hypertensive, while those who participated in strength training were found to be protected from cardiovascular risk (Granado et al., 2009).

Stress and Cardiovascular Response

Three systems in the body affect blood pressure when a stressor occurs: neurological, endocrine, and renal (Figure 1). The first system, the neurological system, serves as a network that transmits messages to and from the brain to the various systems that control blood pressure. When a person is physically or psychologically stressed, the limbic system (the emotional response center in the brain) activates a part of the brain called the hypothalamus (Larkin 2005). The hypothalamus triggers two pathways: a neurological pathway (autonomic nervous system) and an endocrine pathway (McEwen, 1998). In the autonomic nervous system there are two subsystems: the sympathetic nervous system (which is responsible for dynamic change in the body) and the parasympathetic nervous system (which is responsible for returning the body to homeostasis) (Larkin 2005). Within the sympathetic nervous system, there are two pathways: the alpha-adrenergic and the beta-adrenergic (Larkin, 2005). The alpha-adrenergic path causes the blood vessels to constrict, whereas the beta-adrenergic path affects both the heart and blood vessels, causing an increase in heart rate and vasodilation (Larkin, 2005). As for the parasympathetic nervous system, it affects the cardiovascular system via the vagus nerve by decreasing the heart rate (Larkin, 2005).

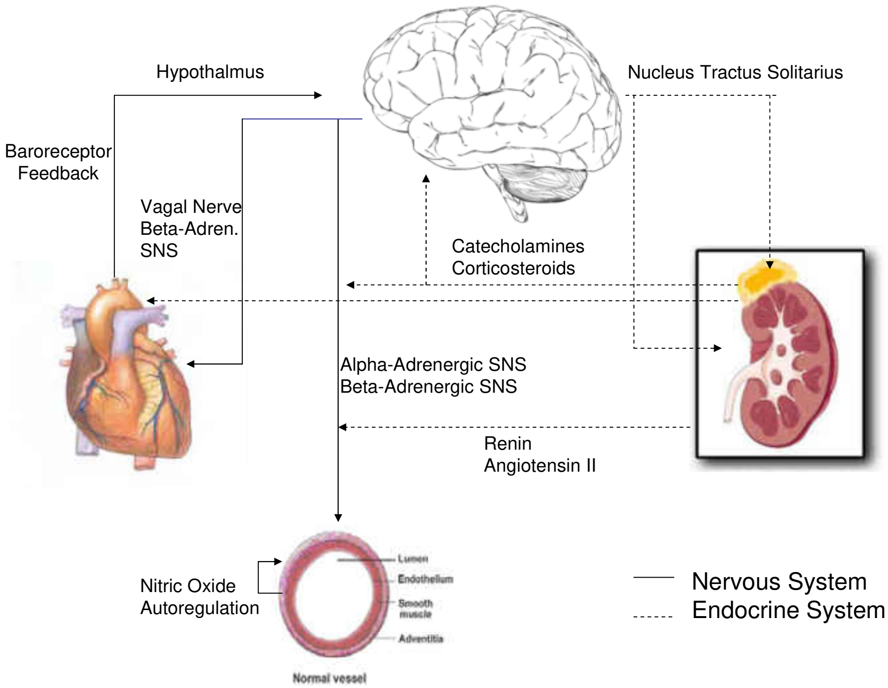


Figure 1. Systems Involved in the Regulation of Blood Pressure
Adapted from www.severehypertension.net

The second system that influences blood pressure is the endocrine system. When the hypothalamus is triggered, corticotropin-releasing factor stimulates the pituitary gland, which releases the adrenocorticotropic hormone (ACTH) that triggers the adrenal glands (Guyton & Hall, 2006). The adrenal glands are affected in two ways. First, the adrenal medulla secretes catecholamines, epinephrine, and norepinephrine (Guyton et al., 2006). The effects of these catecholamines are dependent upon the receptor sites located on the cell membranes of the target organs (Guyton et al, 2006). Norepinephrine works on the alpha adrenergic receptors, resulting in vasoconstriction, bladder sphincter contraction, increased gastrointestinal sphincter tone, increased sweating, increased gluconeogenesis, decreased glucagon and insulin release, and dilated pupils (Guyton et al., 2006) Epinephrine, on the other hand, works on the beta adrenergic receptors, which results in increased heart contractility, vasodilation, decreased gastrointestinal motility, increased renin release, bronchiole dilation, bladder relaxation, increased glucagon, and insulin release and lipolysis (Guyton et al., 2006). The second way the adrenal glands influence blood pressure is via the adrenal cortex. The cortex releases the corticosteroid, cortisol, which facilitates the function of norepinephrine and epinephrine (Larkin, 2005). Cortisol also causes sodium retention, which draws water from the tissue back into the blood vessels, in turn causing an increase in fluid volume with an end result of increased blood pressure (Carretero & Oparil, 2000). Since the endocrine system is dependent upon the circulatory systems to transport the hormones, this response is usually delayed (Larkin, 2005). Like the harmonious balance between the sympathetic and parasympathetic system, norepinephrine increases vasoconstriction while epinephrine dilates the vessels (Larkin, 2005). Both, however, increase the heart rate (Larkin, 2005).

The third and final system, which is often considered the most important influence on blood pressure, is the renal system. Based upon the vascular pressure detected by the kidneys, urine excretion is increased or decreased to alter the blood volume within the vessels (Larkin, 2005). When blood pressure decreases, renin is released from the kidneys, which causes vasoconstriction and sodium retention in hopes of reestablishing the pressure (Larkin, 2005). Renin converts angiotensin to angiotensin II (a vasoconstricting hormone), which signals the adrenal cortex to secrete aldosterone; this, in turn, causes the body to retain sodium by drawing water back into the vessels to increase fluid volume, and hence increase blood pressure, just as in cortisol (Larkin, 2005).

Two other important chemicals affect blood pressure: vasopressin and endothelin. However, their mechanisms are not directly related to stress. Vasopressin, known as the antidiuretic hormone, is secreted from the posterior pituitary gland, which increases water absorption in the renal tubules, causing increased blood pressure (Guyton et al., 2006). Endothelin is a vasoconstricting chemical that is released from the endothelial cell whenever a blood vessel is damaged (Guyton et al., 2006). This chemical reaction secondary to blood vessels damage increases blood pressure, causing more damage and starting the cycle all over again.

One hallmark study that evaluated cardiovascular response to stress in a young population was the Coronary Artery Risk Development in Young Adults (CARDIA) Study. This longitudinal cohort study begun in 1985 assessed cardiovascular response in 5,115 white and black men and women between the ages of 18-30 years at entry (Matthews, Katholi, McCreath, Whooley, Williams, Zhu, 2004). At the 13-year follow-up, blood pressure response was assessed using three stressors:

1. Cold pressor
2. Star tracing
3. Video games

After adjustment for race, gender, covariates (education, BMI, age, resting pressure), and significant interactions, it was found that a greater cardiovascular responses (change in heart/ blood pressure) to the three stressors resulted in earlier development of hypertension ($p<0.0001$ to <0.01) (Matthews et al., 2004). This substantiated the assumption of a direct relationship between stress and cardiovascular response and that over time this can lead to hypertension.

Cardiovascular Measures as Predictors for Cardiovascular Risk

In response to stress, several cardiovascular indices have been shown to be predictors of future hypertension. These are systolic and diastolic blood pressure, mean arterial pressure, cardiovascular recovery, morning blood pressure surge, and evening blood pressure decline. Although studies have mixed findings, systolic blood pressure, diastolic blood pressure, and mean arterial pressure have been identified as stronger predictors of cardiovascular disease in younger men, whereas systolic blood pressure and pulse pressures have been predictors in older men (Sesso, Stampfer, Rosner, Hennekens, Gaziano, Manson et al., 2000).

Blood Pressure and Mean Arterial Pressure

Blood Pressure

Studies have shown that sustained pre-hypertension (blood pressure >130/80 mm Hg and < 140/90 mm Hg) is indicative of future hypertension (Rosamond et al., 2008). In a retrospective analysis of 367 male aviators who became hypertensive over time, 48% of them were pre-hypertensive at age 18. Those who were pre-hypertensive had systolic pressures of 132 ± 6 mm Hg and diastolic pressures of 76 ± 8 mm Hg, versus those who were not, who had systolic pressures of 115 ± 6 mm Hg and diastolic pressures of 72 ± 7 mmHg ($p < 0.001$). Higher resting heart rates (71 ± 12) were found in the pre-hypertensive group versus those found in the normotensive group (65 ± 12 bpm; $p < 0.001$). Finally, those who were pre-hypertensive had higher BMI (22.4 ± 2.9 kg/m^2) when compared to the normotensive group (21.7 ± 2.5 kg/m^2; $p < 0.05$) (Grossman, Grossman, Barenboim, Azaria Goldstein & Grossman, 2006). Also at follow- up, 30% of the sample (pre-hypertensives [*n* 77] and normotensives [*n* 33]) developed hypertension (Grossman et al., 2006). These findings substantiate that fact that pre-hypertension in the young could increase their risk for future hypertension.

Mean Arterial Pressure

Although mean arterial pressure (2/3 diastolic blood pressure + 1/3 systolic blood pressure) is an important tool for assessing perfusion, this measure has also been a predictor of several cardiovascular diseases (Millar, Lever & Burke, 1999). Since hypertension classifications address systolic and diastolic blood pressure individually, mean arterial pressure may give a more complete analysis. In a clinical trial assessing the efficacy of several antihypertensive medications, a sample of 17,354 previously untreated patients (9,048 male and 8,306 female) were randomized into three groups:

1. Placebo (*n* 8654)
2. Bendroftuazide (*n* 4297)
3. Propranolol (*n* 4403) (Millar et al., 1999)

Blood pressure measures were obtained at three, six, nine, and 12 months, and then every six months for a 66-month duration, to determine if blood pressure, mean arterial pressure, or pulse pressure were predictors of cardiovascular disease (Millar et al., 1999). Logistical regression and Cox regression analyses showed that pulse pressure was the strongest predictor of coronary events in males (Millar et al., 1999). However, mean arterial pressure was more predictive of stroke, one of hypertension’s deadliest consequences (Millar et al., 1999). At the beginning of the trial, the pulse pressure was weakly correlated in both sexes with diastolic blood pressure ($r = 0.05$, $p < 0.0001$) and heart rate ($r = 0.09$, $p < 0.001$), but strong with age ($r = 0.35$, $p < 0.001$), and stronger with systolic blood pressure ($r = 0.94$, $p < 0.0001$) (Millar, et al., 1999). These findings indicate that certain cardiovascular indices are stronger predictors than others when considering risk for different cardiovascular diseases. This supports utilizing a combination of cardiovascular indices when assess cardiovascular risk.

Morning Surge and Evening Decline

One important cardiovascular measure is the circadian variation of blood pressure throughout the day. Blood pressure normally declines at night, surges upon awakening, and remains elevated throughout the day (Giles & Izzo, 2008). People with a dysregulated system have a greater surge magnitude in the morning and a blood pressure that does not drop at least 10% when they are asleep (Kikuya, Hozawa, Ohokubo, Tsuji, Michimata, Matsubara et al., 2000; Stolarz, Staessen & O'Brien, 2002; Giles et al., 2008). Although morning blood pressure surge has been identified as a significant predictor of stroke in the elderly, this surge can be attributed to factors such as the over-activation of the alpha adrenergic system, which is often seen in stress (Kario, Pickering, Hoshide, Eguchi, Ishikawa, Morinari et al., 2004). Other factors were noted in a study of 1,419 untreated hypertensive patients, where a morning surge $\geq$ 25 mm Hg was found to be associated with alcohol consumption, smoking, longer sleep duration, later waking hours, and increased blood pressure variability (Neutel, Schumacher, Gosse, Lacourciere & Williams, 2008). As for evening blood pressure decline, a "non-dipper" is defined as an individual with a nocturnal blood pressure less than 10% of the mean daytime blood pressure (Stolarz et al., 2002). This measure is important; for each 5% increment in the systolic or diastolic blood pressure night-to-day ratio, there is a 20% increase of risk of cardiovascular mortality, even if the blood pressure is within normal limits (Stolarz et al., 2002).

In the prospective *Progetto Iperetensione Umbria Monitoraggio Ambulatoriale* (PIUMA) study, cardiovascular morbidity increased in those who were non-dippers (RR 6.26, 95% CI 1.92-20.32) when compared to those with dipper status (RR 3.70, 95% CI 1.13-12.5) (Verdecchia, Schillaci, Borgioni, Ciucci, Gattobigio, & Porcellati, 1996). When age, gender, diabetes, and left ventricular hypertrophy were controlled, women with hypertension who were non-dippers had higher cardiovascular morbidity at the time of follow-up (RR 6.79; $p = 0.0002$) (Verdecchia et al., 1996). When night:day blood pressure ratios were assessed, there was an increase in cardiovascular events in both genders when the ratio increased (Verdecchia et al., 1996). Another evaluation of the PIUMA data showed the incidence of cardiovascular events per 1,000 patients to be 4.7 in the normotensive group, 17.9 in the dipper group, and a dramatic 49.9 in non-dipper group (Verdecchia et al., 1996). This non-dipping effect can exacerbate the risk for those life-threatening cardiovascular events that often occur in the morning hours during the first two hours of rising (Verdecchia et al., 1996).

Another study conducted to assess if morning blood pressure surge had a negative impact on the cardiovascular system was a prospective study of 519 older hypertensives. The morning blood pressure surge was calculated by taking the mean systolic blood pressure during the first two hours after awakening minus mean systolic blood pressure during the one hour that included the lowest sleeping blood pressure (Kario et al, 2003). During the 41-month time span, 44 strokes occurred (Kario et al., 2003). Those with a morning surge $\geq$ 55 mm Hg (*n* 53) had a higher prevalence of multiple infarctions (57% versus 33%; $p = 0.001$) and a higher prevalence of stroke (19% versus 7.3%; $p = 0.004$) (Kario et al, 2003). The relative risk of the morning surge group and the non-morning surge group was significant (RR 2.7; $p = 0.04$), showing that as adults with hypertension get older, a higher morning blood pressure surge could be detrimental.

Table 3. Review of Literature

Article	Setting	Sample	Tool(s)	Intervention(s)	Design	Outcome
Clark, M., Bond, M.& Hecker, J. (2007)		57 caregivers of spouses with new dementia up to 1 year since diagnosis 88 caregivers for 2 years or more (n 88) 53 non-caregivers	Laboratory values Anthropometric measurements Geriatric Social Readjustment Rating Scale Perceived Stress Scale	N/A	Prospective analysis	Both new caregivers and veteran caregivers exhibited increases in primary mediators (urinary cortisol, urinary epinephrine and norepinephrine, and serum dehydroepiandrostorone-ester [DHEA-S]).
Covelli, M. (2006)	High school located in Central Florida	48 African-American adolescents (31 with family history of HTN and 17 with no family history of HTN)	Laboratory values Blood pressure measurements	Cold pressor test of hand immersion in cold water	Quasi-experimental Repeated measures	No significant difference between the groups in regard to cortisol reactivity (F = .389, p = .844); however, those with a family history of HTN demonstrated significant cardiovascular reactivity (χ^2 = 8.813, p = .004).

Article	Setting	Sample	Tool(s)	Intervention(s)	Design	Outcome
Eisen, S., Kang, H., Murphy, F., Blanchard, M., Reda, D., Henderson W. et al., (2005)	Veterans Administration hospitals throughout the U. S.	30,000 deployed and non deployed Gulf War veterans	National Health Survey of Gulf War Era Veterans	N/A	Prospective cross-sectional analysis	10 years after deployment, 13.6% of the deployed veterans developed hypertension vs. 7.8% of the non-deployed veterans.
Granado, N., Smith, T., Swanson, G., Harris, R., Shahar, E., Smith B. et al., (2009)	Army installations throughout the U. S.	55,021 recently deployed soldiers	National Health Survey of Gulf War Era Veterans	N/A	Prospective cross-sectional analysis	Soldiers who had combat exposure were more likely to develop hypertension than those who did not have combat exposures (1.28, 95% CI, 1.04-1.58).
Gray, G., Reed, R., Kaiser, K., Smith, T. & Gastanaga, V. (2002)	Navy installations throughout the U.S.	3,831 Navy Seabees who deployed to the Persian Gulf 4933 Navy Seabees who deployed elsewhere 3104 non-deployed Navy Seabees	Questionnaire	N/A	Prospective cross-sectional analysis	7 years after the Gulf War, a higher prevalence of hypertension was found in the Navy Seabees who deployed to the Persian Gulf (OR 1.82, 95% CI 1.48-2.26)

Article	Setting	Sample	Tool(s)	Intervention(s)	Design	Outcome
Grossman, A., Grossman, C. Barenboim, E. Azaria, B. Goldstein, L. & Grossman, E. (2006)	Israeli Air Force	367 male aviators	Anthropometric instruments and blood pressure monitor	N/A	Longitudinal and retrospective analysis	Of those who became hypertensive, 48% were pre-hypertensive at age 18 (132 +6/76 + 8 versus 115 + 6/72 + 7 mmHg; $p < 0.001$), had higher resting heart rates (71 + 12 vs. 65 + 12 bpm; $p < 0.001$), and higher BMIs (22.4 + 2.9 versus 21.7 + 2.5 kg/m^2; $p < 0.05$) when compared to those with normal blood pressures.
Kario, K. Pickering, T. Umeda, Y., Hoshide, S. Hoshide, Y., Morinari, M. et al., (2003)	Multisite (various health care facilities throughout Japan)	519 hypertensive men and women	Blood pressure monitor (2 hour duration upon awakening and 1 hour duration when asleep)	N/A	Prospective analysis	Those with morning blood pressure surges > 55 mm Hg ($n = 53$) had a higher prevalence of multiple infarcts (57% versus 33%).
Li, R., Alpert, B., Walker, S. & Somes, G. (2007)	Public school in Obion County, Tennessee	315 students	Anthropometric instruments and blood pressure monitor	Video games (lasting 10 minutes)	Longitudinal analysis	Children with a parental history of hypertension (27.5%) had higher BMIs (21.6 versus 19.9, $p = .001$) and showed a greater systolic cardiovascular response (17.2 versus 14.9, $p = .01$).

Article	Setting	Sample	Tool(s)	Intervention(s)	Design	Outcome
Light, K., Turner, R. & Hinderliter, A. (1992)	University of North Carolina at Chapel Medical Center	129 healthy, normotensive adults	Ambulatory blood pressure monitor Job Content Questionnaire	N/A	Prospective (repeated measures) analysis	Men identified as having high-strain jobs showed greater cardiovascular response throughout the day (SBP: + 9.9 mm Hg versus 3.4 mm Hg and DBP: +7.9 mm Hg versus 3.1.mm Hg, p <.03).
Matthews, K., Katholi, C., McCreath, H., Whooley, M., Williams, M., Zhu, S. et al. (2004)	Multisite (Birmingham, AL; Chicago, IL; Minneapolis, MN; and Oakland, CA)	5,115 normotensive black and white men and women	Anthropometric instruments and blood pressure monitor	Cold pressor, star tracing (mirror image), and video game tasks	Longitudinal analysis	After 13 years, those with increased stress response developed hypertension, with the majority of them being black. Those who were more prone to become hypertensive were older, less educated, and had a higher resting BP and higher BMI.
McCauley, L., Lasarev, M., Sticker, D., Rischitelli, D. & Spencer, P. (2002)	Veteran Administration hospitals throughout the U.S.	1,263 deployed veterans 516 non-deployed veterans	Questionnaire	N/A	Prospective	8 years after deployment, there was a higher prevalence of hypertension in deployed veterans (OR 1.7, 95% CI 1.3-2.4).

Article	Setting	Sample	Tool(s)	Intervention(s)	Design	Outcome
McGraw, L., Turner, B., Stotts, N. & Dracup, K. (2008)	Army installations throughout the U.S.	15,391 active duty service members	Health Risk Appraisal survey	N/A	Retrospective, cross-sectional analysis	13% were found to be hypertensive and 62% were found to be pre-hypertensive. Age, BMI, male gender, and higher rank were associated with pre-hypertensive
Millar, J., Lever, A. & Burke, V. (1999)	Multisite (Various hospitals throughout the United Kingdom)	17,354 mildly hypertensive men and women	Blood pressure monitor	Bendrofluazide and Propanolol Placebo	Prospective	1 year follow-up showed that pulse pressure was a strong predictor of coronary events and mean arterial pressure was a strong predictor of stroke in males.
Neutel, J., Schumacher, H., Gosse, P., Lacourciere, Y. & Williams, B. (2008)	Multisite (Various hospitals throughout the U.S., Canada, UK, France, and Germany	1,419 untreated hypertensive patients	Ambulatory blood pressure monitor	N/A	Prospective analysis	Those who consumed alcohol, smoked, had long sleep duration, late wake time, and increased BP variability had morning surges $\geq$ 25 mm Hg.

Article	Setting	Sample	Tool(s)	Intervention(s)	Design	Outcome
Smoley, B. Smith, N. & Runkle, G. (2008)	Army installations throughout the U.S.	15,391 active duty service members	Health Risk Appraisal survey	N/A	Retrospective, cross-sectional analysis	13% were found to be hypertensive and 62% were found to be pre-hypertensive. Age, BMI, male gender, and higher rank were associated with pre-hypertensive
Steptoe, A. & Marmot, M. (2005)	Multisite (various healthcare facilities in London)	209 normotensive men and women (age 45-59 at baseline)	Blood pressure monitor	Stressful behavioral tasks	Longitudinal analysis	Over the course of 3 years, those with poor poststressor recovery were more likely to have increased systolic blood pressure (OR 3.5, 95% CI, 1.19-10.8) when compared to those with effective poststressor recovery.

Article	Setting	Sample	Tool(s)	Intervention(s)	Design	Outcome
Tucker, Vogel, Lincoln, Dunn, Ahrensfield, Allen, et al. (2009)	National Football League CARDIA Study database	504 active and veteran NFL players CARDIA study participants (age 23-35 in 1985-1986)	Laboratory Values Anthropometric measurements Blood pressure monitor	N/A	Cross-sectional analysis	65% ([*n* = 310] 95% CI, 58.3%-70.7%) of the NFL players versus 24.2% ([*n* = 473] 95%CI, 22.3%-26.1%) of the general population were classified as pre-hypertensive (p< .001). Also, 13.8% ([*n* = 67] 95% CI, 11%-16.7%) of the NFL sample versus 5.5% ([*n* = 108] 95% CI, 4.6%-6.6%) of the general population were identified (p< .001). High BMI was associated with pre-hypertension and hypertension.
Verdecchia, P., Schillaci, G., Borgioni, C., Ciucci, A., Gattobigio, R. & Porcellati, C. (1996)	Multisite (various hospital throughout Italy)	1,717 men and women	Ambulatory blood pressure monitor	N/A	Prospective analysis	Cardiovascular events per 1,000 patients were 4.7 in the normotensive group, 17.9 in the dipper group, and 49.9 in the non-dipper group.

Conceptual Framework

Since the stressful factors surrounding military deployment may be the key difference between the risk for hypertension in a military population versus a civilian population, a theoretical framework assessing the physiologic responses to stress was used in this study. The Allostasis and Allostatic Load theoretical framework, attributed to the works of Bruce McEwen, depicts how individual differences (e.g., genetics, age, life experience, family history, etc.), perceived stress (e.g., helplessness, vigilance, etc.), and health behaviors (e.g., diet, exercise, smoking, etc.) greatly contribute to one's physiologic response to a stressor (Fisher & Reason, 1988; McEwen, 1998) (Figure 2). When one is stressed, whether psychological or physical, the body attempts to protect itself through a complicated balancing act. Allostasis, a term first introduced by Peter Sterling and Joseph Eyer in 1988, is the concept of maintaining homeostasis through change (Fisher et al., 1988). Through allostasis, the autonomic nervous system and the hypothalamus-pituitary-adrenal (HPA) axis; along with the cardiovascular, metabolic, and immune systems; protect the body from to internal and external stressors (McEwen, 1998). If the mediators of allostasis (e.g., adrenal hormones, neurotransmitters, or immuno-cytokines) are activated too often or too long, fail to disengage, or are inefficiently managed, this wear and tear manifests into what is known as the Allostatic Load (McEwen, 1998). This load over an extended period of time can evolve into chronic disease. With the influence of individual differences, perceived stress, and behaviors, four distinct paths can lead to an Allostatic Load:

1. Repeated stress (e.g., multiple deployments)
2. Prolonged stress (e.g., deployment over a year)
3. Lack of adaptation (e.g., less than 10% drop in blood pressure at night)

4. Inadequate response (e.g., inflammation and auto immune response) (McEwen, 1998).

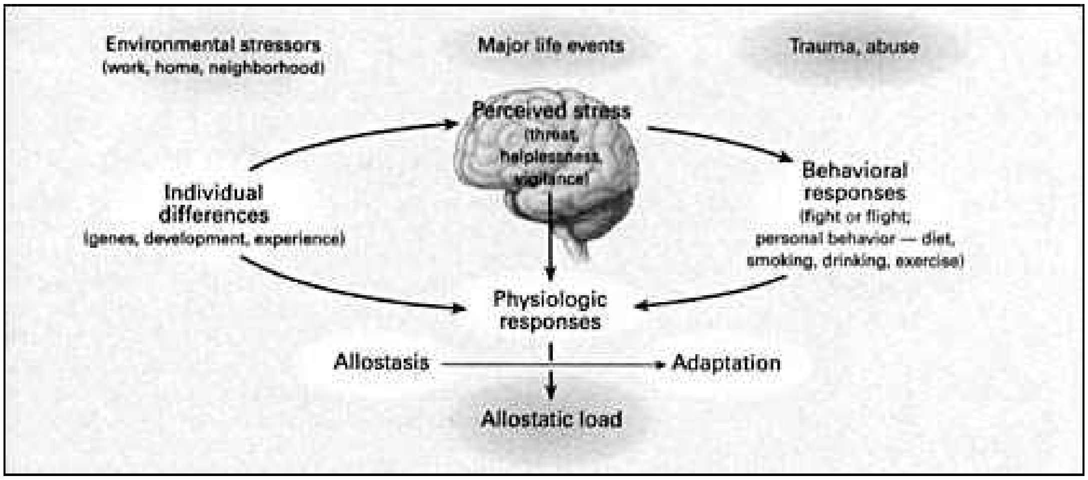


Figure 2. Bruce McEwen's Allostasis/Allostatic Load Framework (McEwen, 1998)

An example of the use of this framework is a study that was conducted to assess the physiologic outcome of stress in three groups:

1. Caregivers of spouses with new dementia up to one year since diagnosis (*n* 57)
2. Caregivers for two years or more (*n* 88)
3. Non-caregivers (*n* 53) (Clark, Bond & Hecker, 2007).

To quantify primary stress mediators, urinary cortisol, urinary epinephrine and norepinephrine, and serum dehydroepiandrostorone-ester (DHEA-S) were collected (Clark et al., 2007). Blood pressure, waist to hip ratio, serum high density lipids (HDL), HDL-total cholesterol ratio, and blood plasma levels of total glycosylated hemoglobin were collected as secondary stress mediators (Clark et al., 2007). To obtain psychologic measures, the Geriatric Social Readjustment Rating Scale was used to measure environmental stress, and the Perceived Stress Scale measured psychological stress (Clark et al., 2007). When a series 2 by 3 repeated measures

ANOVA was conducted to compare year 1 and year 2 data, both new caregivers and veteran caregivers exhibited increases in their primary mediators (Clark et al, 2007). No change occurred in the non-caregivers, providing evidence that stress over time can manifest into some form of measureable physiologic response.

Application of Framework to Research Study

Although this framework focuses on the long-term effects of stress over time, the influencing factors are the same whether the response is acute or chronic. Figure 3 depicts how this framework was applied to the study.

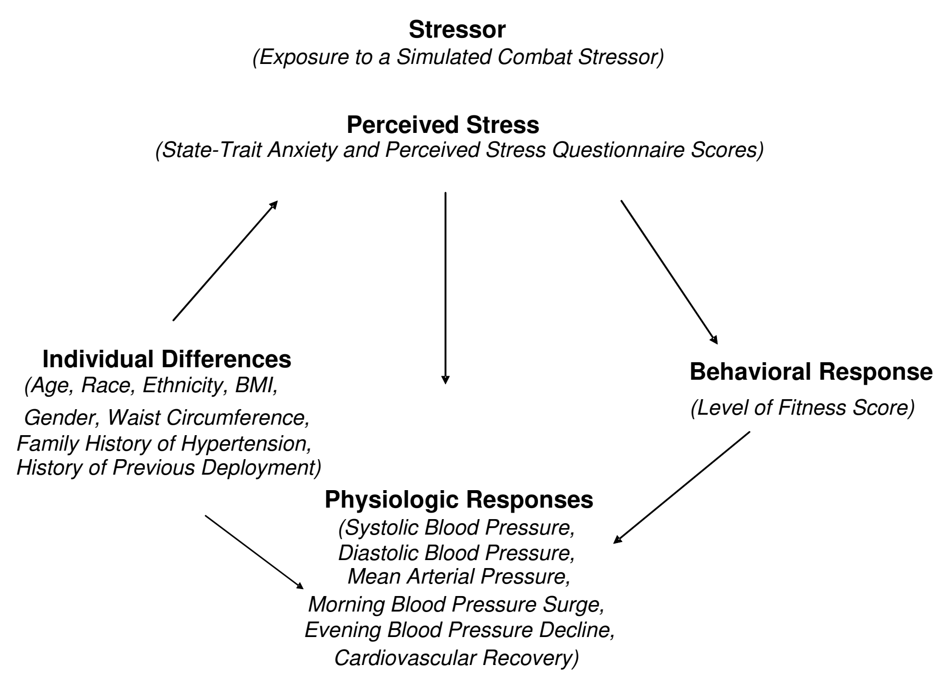


Figure 3. Framework as Applied to Research Study

Summary

A review of the literature showed that hypertension is a leading risk factor in the manifestation of many cardiovascular diseases. Stress, family history, and high BMI have been found as the most common risk factors for hypertension among the young. Although the military is made up of a cohort of young fit individuals, there is a high prevalence of hypertension risk factors among this population. Of those risk factors, stress as a consequence of multiple military deployments may be the most salient. The review of literature also showed that most of the military studies utilized self-reported information extracted from questionnaires and databases. Due to the insufficient quantity, quality, and consistency of hypertension studies in the military, this topic warrants further investigation.

The Allostasis and Allostatic Load framework is an ideal framework to guide research that assesses the effect of various factors on the physiologic response to stress. Individual differences, perceived stress and health behaviors could tremendously impact one's physiologic response to stress. Several cardiovascular measures (blood pressure, mean arterial pressure, morning blood pressure surge, evening blood pressure decline, and cardiovascular recovery) have been identified as predictors of cardiovascular disease and by assessing and identifying which factors that influence them, researchers and health care providers may be able to better identify those at risk for future hypertension.

CHAPTER THREE: METHODS

Design and Research Methods

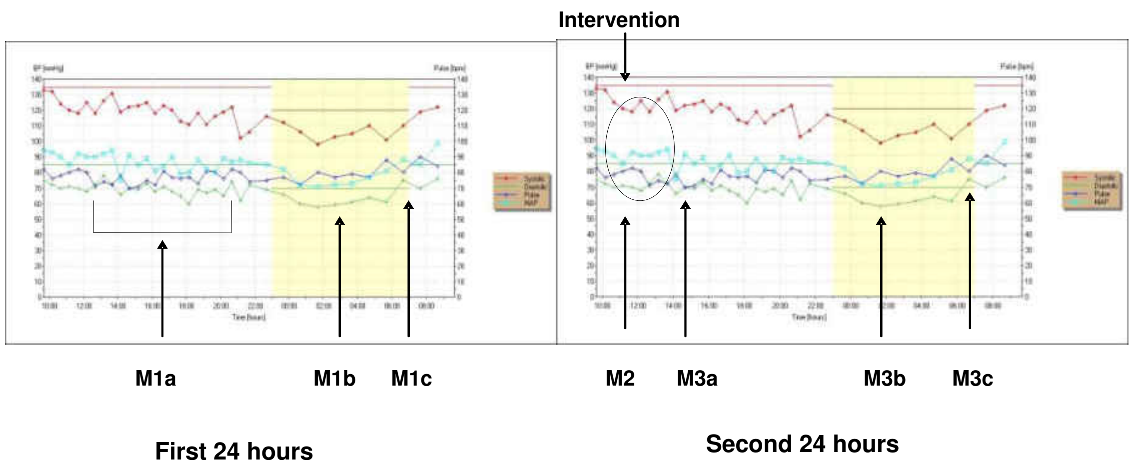
The research design and methods to assess cardiovascular response to a simulated combat stressor are discussed in this chapter.

Design

Since intervals of continuous cardiovascular measures are necessary to answer the research questions, a repeated measure (three intervals of measures) design was be used. In the algorithm below (Figure 4), M represents the various measures that occurred over the three-day data collection period, while X depicts the exposure to the stressor (Figures 4 and 5).

M1 →	X (M2) →	M3
Prestressor	During Stressor	Poststressor

Figure 4. Repeated Measure Design



M1a – Waking Measures (prestressor)
M1b – Sleeping Measures (prestressor)
M1c – Morning Surge (prestressor)

M2 - Stressor
M3a – Recovery and Waking Measures (poststressor)
M3b – Sleeping Measures (poststressor)
M3c – Morning Surge (poststressor)

Figure 5. Graphic Depiction of Repeated Measure Design (Adapted from Tiba Medical, 2008)

Possible Extraneous Variables

Since the stress response can be triggered from a variety of physical and psychological stressors, many variables cannot be controlled. First, to minimize this threat, caution was taken to avoid some variables when scheduling each participant for his/her data collecting rotation (e.g., exam schedules, assignment deadlines, scheduled personal life events, etc.). Second, by scheduling the two 24-hour measures back to back, this decreased the time window in which other extraneous variables could be introduced.

Subjects and Sampling

Subjects

The study population consisted of students in the Army Reserve Officer Training Corps (ROTC) program at the University of Central Florida's (UCF) Orlando campus. This population was selected because they closely represented the 2009 demographics of the U.S. Army's enlisted corps (Caucasians 61.1%, African -Americans 20.9%, Hispanics 12%, Asians 3.5%, and Other 2.5%) (United States Army, 2009).

Army ROTC is an elective Department of Defense-funded program that students take along with their required college courses (Army ROTC, 2009). The program is structured to prepared young men and women to serve as officers in the U.S. Army (Army ROTC, 2009). Classes are based on Army doctrine, team building, physical fitness, and leadership of troops in and out of combat scenarios. Freshmen and sophomores over the age of 18 may participate in the ROTC program without any obligation to join the Army (Army ROTC, 2009). However, students who receive Army scholarships or enter the program at the junior and senior levels must agree to serve full-time in the Army for three to four years after graduation (Army ROTC, 2009). Some cadets may serve part-time in the U.S. Army Reserve or Army National Guard (Army ROTC, 2009). Upon graduation from college, students are commissioned as Second Lieutenants and are assigned to various branches throughout the U.S. Army (Army ROTC, 2009).

Cadets were selected for this study due to the level of combat training they receive to prepare for the national Leadership Development Assessment Course, which takes place during the summer between their junior and senior year. This training closely resembles the combat experience often seen in the active duty combat environment. Cadets were also selected because after they are commissioned into the Army, it will be feasible to follow up on their cardiovascular health status.

Inclusion/Exclusion Criteria

The inclusion criteria for the study included all cadets who a) were over the age of 17 and b) were scheduled to participate in a paintball combat exercise as part of their training between January 2010 and April 2010. Exclusion criteria included those who a) were under the age of 18, b) had any known history of cardiovascular health issues, c) used antihypertensive medication for any reason, and d) were unable to wear the ambulatory blood pressure monitor for 48 continuous hours (Table 4).

Table 4. Rationale for Exclusion of Subjects

Exclusion Criteria	Rationale
Age	To avoid the risk of recruiting a population deemed vulnerable by the Institutional Review Board, participants under the age of 18 were not recruited.
Known history of cardiovascular health issues (e.g., any diseases of the circulatory system that fall under ICD-10 codes I00-I99).	The presence of cardiovascular health issues could affect the attainment of pure cardiovascular measures. This could also increase or diminish the effect of the stressor.
The use of any drugs classified as an antihypertensive (e.g., ACE inhibitors, adrenergic receptor agonists, adrenergic receptor antagonists, aldosterone antagonists, angiotensin II receptor antagonists, calcium channel blockers, centrally acting adrenergics, diuretics, and vasodilators).	Antihypertensive medication can alter blood pressure and diminish the effect of the stressor
The inability to wear ambulatory blood pressure monitor for two 24-hour periods.	A complete 24-hour prestressor measure is necessary to establish a baseline to which the 24-hour during and poststressor measures can be compared. Any missing measures could affect the accuracy of the statistical analysis.

Sample

A power analysis was conducted utilizing the G*Power (version 3.0.8, Mannheim, Germany) software. Since the research question involved obtaining measures at several intervals, a repeated measure (within factors) Analysis of Variance (ANOVA) test was selected using the variables listed in research question 1a-c (comparing the SBP, DBP and MAP before, during, and after the stressor) to conduct the power analysis. Using an effect size of 0.25, error probability of .05, and a power of .80, it was determined that a sample size of 48 cadets was needed for the study. Assuming that 80% of the cadets would wear the ambulatory blood pressure monitors for the required hours, a sample size of 60 was recruited.

Variables

The independent variable, *exposure to a simulated combat stressor*, was defined as the exposure to a reproduction of an orchestrated struggle between opposing individuals or forces in a military setting (Merriam-Webster, 2003). For the purpose of this study, participation in a three- to four-hour paintball exercise served as the simulated combat stressor.

Paintball is an appropriate stressor for this study for several reasons. First, the experience is similar to what is often experienced in combat. The use of weapons, reliance on physical stamina, and problem-solving and teamwork make paintball a suitable proxy for a combat stressor. Second, unlike running on a treadmill, which is often used for cardiovascular tests, the intensity and duration of paintball is unpredictable, which may provide rich cardiovascular reactivity data. Finally, there is a psychological component to paintball that is not often experienced when running on treadmill. In paintball, the participant is trying to reach an object and protect himself/herself, all while under a heightened state of awareness or fear.

Paintball is considered a sport, and under proper supervision, is very safe. In a study using the National Electronic Injury Surveillance System (NEISS) database, researchers found that 11,998 patients age 7 and older were treated in emergency departments for non-fatal paintball injuries between 1997 and 2001 (4.5 per 10,000 persons [95% CI, 3.3 to 5.7]) (Conn, Annest, Gilchrist & Ryan, 2004). For those ages 7-17 (76.9%), the most common injuries were due to the paint-filled, gelatin-coated ball; these injuries were 1.7 times higher (*p*, = 0.0001) than those of individuals who were 18 or older (Conn et al., 2004). For those 18 or older, overexertion and falls were found to be the most common injuries (39.1%) (Conn et al., 2004). When supervision, rules of engagement, and safety equipment are added, this risk decreases substantially (Conn et al, 2004).

The dependent variable, *cardiovascular response*, is defined as the magnitude of cardiovascular changes that occur during and/or after the exposure to a stressor (Cacioppi, 2007). Mathematically, this is depicted as "measure" $_{\text{stressor period}}$ (minus) "measure" $_{\text{prestressor period}}$ (Cacioppi, 1997). For the purpose of this study, cardiovascular response was measured by:

a. Comparing the systolic blood pressures (before, during, and after the stressor).
b. Comparing the diastolic blood pressures (before, during, and after the stressor).
c. Comparing the mean arterial pressures (before, during, and after the stressor).
d. Assessing the number of mm Hg the systolic blood pressure declined after the stressor ceased.
e. Comparing the pre and poststressor morning blood pressure surges.
f. Comparing the pre and poststressor evening blood pressure declines.

The characteristics that were correlated with the cardiovascular response include the three groups of factors listed in the theoretical framework as having influence on the stress response: 1) *individual differences* (e.g., age, race, ethnicity, gender, BMI, waist circumference, family history of hypertension, and history of previous deployment), 2) *perceived stress* (e.g., State-Trait Anxiety Inventory and Paintball Exercise Questionnaire scores), and 3) *health behavior* (e.g., Army Physical Fitness Test (APFT) score).

Table 5. Table of Variables

Variable	Level of Measurement	Source	Time(s) of Assessment	Purpose
Individual Differences (Demographics)				
Age, gender, race, ethnicity, BMI, waist circumference, family history of hypertension, history of previous deployment	Categorical	Interview Army Physical Fitness Test (APFT) score sheet (within the past 3 months)	Baseline	To describe sample
Perceived Stress				
State-Trait Anxiety	Scale	State-Trait Anxiety Inventory (forms Y-1 and Y-2)	Baseline and after paintball exercise	To establish level of anxiety: before and during the paintball exercise
Perceived Stress	Ordinal	Paintball Perceived Stress Questionnaire	After paintball exercise	To establish level of perceived stress before, during and after the paintball exercise
Health Behavior				
Level of Fitness	Scale	APFT Score card (within past three months)	Baseline	To establish a level of fitness
<u>DEPENDENT VARIABLES</u> (Prestressor)				
Systolic Blood Pressure	Scale	Ambulatory blood pressure monitor	Continuous hours starting 2 hours after awakening and ending at bedtime	To establish a baseline.
Diastolic Blood Pressure	Scale	Same as above	Same as above	Same as above
Mean Arterial Pressure	Scale	Same as above	Same as above	Same as above
Pulse Rate	Scale	Same as above	Same as above	Same as above
Percentage the Evening Blood Pressure Declined	Scale	Same as above	Continuous hours starting from bedtime and ending once awakened the next morning	Same as above
Magnitude of Morning Blood Pressure Surge	Scale	Same as above	Continuous hours starting from the time awakened and ending 2 hours later	Same as above

<u>DEPENDENT VARIABLES</u> **(During Stressor)**				
Systolic Blood Pressure	Scale	Ambulatory Blood Pressure Monitor	Continuous hours starting at the beginning of the paintball exercise and ending at the end of the exercise	To compare to baseline to establish level of response to stressor
Diastolic Blood Pressure	Scale	Same as above	Same as above	Same as above
Mean Arterial Pressure	Scale	Same as above	Same as above	Same as above
Pulse Rate	Scale	Same as above	Same as above	Same as above
<u>DEPENDENT VARIABLES</u> **(Poststressor)**				
Cardiovascular Recovery	Scale	Ambulatory Blood Pressure Monitor	Continuous for 1 hour starting immediately after the end of the paintball exercise	To measure how much the blood pressure declined after the stressor ceased
Systolic Blood Pressure	Scale	Same as above	Continuous hours starting 2 hours after awakening and ending at bed time	To compare to baseline to establish level of response to stressor.
Diastolic Blood Pressure	Scale	Same as above	Same as above	Same as above
Mean Arterial Pressure	Scale	Same as above	Same as above	Same as above
Pulse Rate	Scale	Same as above	Same as above	Same as above
Percentage the Evening Blood Pressure Declined	Scale	Same as above	Continuous hours starting from bedtime and ending once awakened then next morning	Same as above
Magnitude of morning Blood Pressure Surge	Scale	Same as above	Continuous hours starting from the time awakened and ending 2 hours later	Same as above.

Intervention, Setting, and Implementation

Xtreme Paintball, located at 1300 South Poinciana Boulevard in Kissimmee, Florida, served as the simulated combat environment. This 30-acre property gives sports enthusiasts the opportunity to play simulated combat games against opposing forces. Using two teams, participants play offensive and defensive roles in a variety of settings. Participants were equipped with paintball makers (simulated firearms); gelatin-coated, paint-filled projectiles (simulated bullets); and protective masks. For safety and fair play, each team was assigned a ROTC instructor. Since the data collection occurred simultaneously with the combat training exercise, cardiovascular measures were taken continuously due to the unpredictable nature of the stressor. All scenarios were scripted to follow established Army doctrine and protocol with some added combat-related surprise elements.

Ethical Considerations

Approval

This study was approved by the UCF Institutional Review Board (Appendix A). The Army Human Research Protection Office in Arlington, Virginia also provided consultation on the proper IRB protocol for the use of military subjects. Since the Army ROTC cadets were students of UCF and the combat exercise was deemed to be no greater of a risk than what the cadets were normally exposed to, a risk assessment briefing and letter of support from the Battalion Commander of the ROTC Department were the only military requirements needed. The recruitment flyer (Appendix B) and consent were approved for distribution (Appendix C). A secondary consent was later approved in the event that the study had to be opened to the UCF U.S. Air Force ROTC cadets (Appendix D). Letters of support from all pertinent parties were also obtained (Appendices E, F, and G).

Protection of Human Subjects

Participation in the study was strictly voluntary. An IRB-approved consent was given to each interested cadet to thoroughly explain the context of the research study. Cadets were encouraged to ask any questions in private if there were any concerns before signing the consent.

Cadets were reassured that their non-participation in the study would not be reflected in their grade or impact their current or future military service. To avoid the appearance of coercion, the investigator wore civilian attire during any communication with cadets and stated that she is a doctoral student in UCF's College of Nursing, rather than stating she was a Lieutenant Colonel in the U.S. Army Nurse Corps.

The cadets were informed that they had the right to withdraw from the study at any time. Consents also stated that information obtained during the study would not be discussed with their chain of command and that all results from the cardiovascular measures would be given directly to the cadet. In the event that any cardiovascular measure warranted the consultation of a primary care provider (e.g., blood pressure that is in the hypertension range for more than 50% of the time during the prestressor measures) cadets would have been given a copy of the report and encouraged to seek medical attention as soon as possible.

Potential Risks

The paintball exercise that was used as the stressor for the study was very similar to the type of training that the ROTC cadets were already accustomed to. The only exception was the use of paintball equipment and the wearing of an ambulatory blood pressure monitor. According to Conn et al. (2004), paintball is considered to be a safe team sport, with injury rates of 4.5 per 10,000 persons. However, there is risk of bruising if struck with one of the gelatin-coated, paint-filled markers if unprotected at close range (Conn et al., 2004). To decrease the risk of injury, each participant wore a tactical protection mask and closed-toe shoes with suitable traction per the facility rules and regulations. In the event that any cadet needed medical attention, it would have been handled in the same manner as any other injury that occurs during standard ROTC training exercises. As for the ambulatory blood pressure monitor, there was minimal risk. To decrease sweating and irritation from the blood pressure cuff, a thin layer of Webril (cotton roll) was used under the cuff if requested. To avoid irritation from cuff slippage during movement, the cuffs were equipped with a mechanism that clipped to an adhesive patch, which was applied to the skin. Minimal or no pain occurred with the inflation and deflation of the cuffs after the initial blood pressure reading since the monitors automatically based subsequent maximum pressures on the participant's average blood pressure reading.

Potential Benefits

The Tiba Medical Ambulo 2400 ambulatory blood pressure monitor produced a report of cardiovascular function. This comprehensive report gave each cadet a thorough view of his/her cardiovascular health that would serve as a starting point for instilling positive health behaviors for future cardiovascular health. Another benefit to participating in the study was the opportunity to use paintball as an enhanced training experience.

Confidentiality

To ensure confidentiality, each cadet was assigned an alpha numeric identification number upon enrollment. This identifier was used throughout the study. The document containing full names and identification numbers was kept separate in a locked desk in the investigator's office. The data were saved to two encrypted portable hard drives (one for daily usage and the other for backup). When not in use, the encrypted hard drives were stored a locked file cabinet in the investigator's office. After six years, identification sheet, demographic sheets, and consents will be shredded and disposed. Portable encrypted hard drives will then be erased and reformatted.

Instruments

For this study five instruments were used:

1. Tiba Medical Ambulo 2400 ambulatory blood pressure monitor
2. Participant Information Sheet
3. State-Trait Anxiety Inventory
4. Paintball Exercise Questionnaire
5. Army Physical Fitness Test score sheet

Tiba Medical Ambulo 2400 Ambulatory Blood Pressure Monitor

Since the dependent variables in this study consist of physiologic measures, a biophysiologic instrument was used to collect the data. To obtain cardiovascular measures, the Food and Drug Administration- (FDA) approved Ambulo 2400 ambulatory blood pressure monitor (Tiba Medical, Portland, Oregon) was used (Appendices H and I). This device was selected over other monitors due to its compact size, durability, leasing option, and powerful data analysis software. The device can capture 24 hours of continuous cardiovascular measures in intervals of 5, 10, 15, 20, 25, 30, 45, 60, 75, 90, 105, and 120 minutes (Tiba Medical, 2009) . For this study, the intervals of measure occurred:

1. Every 30 minutes during the pre and poststressor waking hours
2. Every 60 minutes during the pre and poststressor sleeping hours
3. Every 15 minutes during the stressor

The scales of measure range from 60-280 mm Hg systolic, 30-160 mm Hg diastolic, and 30-180 heart rate per minute (Tiba Medical, 2009). Along with cardiovascular data, the device was also able to measure changes in physical activity through an accelerometer, which captures three axis of motion (Tiba Medical, 2009). This feature helped to identify the waking and sleeping cycles so that no diary was necessary.

There are no documented studies using this device. However, according to the manufacturer's specifications, the measurement accuracy for blood pressures is $\pm$ 3 mm Hg mean difference with a $\pm$ 8 mm Hg standard deviation (Tiba Medical, 2009). The memory is capable of saving 3,000 measures and seven days of continuous actigraphy (Tiba Medical, 2009). Measuring at 4.7" x 2.7" x 1.2" and weighing approximately nine ounces, its compact and lightweight design was ideal for the combat environment. The device was powered by two 1.2-volt NiMH rechargeable batteries and connected to a computer via a USB cable to export the data (Tiba Medical, 2009). The accompanying *Hypertension Diagnostic Suite for Microsoft* version 2.30 (Portland, Oregon) software allowed for the captured data to be analyzed and displayed via a table or graph, or by correlated actigraphy and cardiovascular measures (Tiba Medical, 2009). The table data, in Microsoft Excel format, was easily exported to a SPSS datafile for further analysis. The device did not interfere with other electronic equipment within its proximity and was latex free.

Participant Information Sheet

All demographic/descriptive data were documented on the eight-question, self-reported Participant Information Sheet (Appendix J). The only identifying data on this sheet was the study ID number.

State-Trait Anxiety Inventory

Anxiety is defined as an unpleasant state or condition that is induced by stress (Speilberger, 1983). This psychological factor can play a role in how the cardiovascular system responds when one is exposed to a stressor. According to Spielberger (1983), state anxiety is transitory while trait anxiety is stable, and both can be quantified using a tested instrument called the State-Trait Anxiety Inventory (STAI) (Appendix K). This instrument was used to assess the participants' general state of anxiety as well as their state of anxiety during the combat exercise. The instrument consists of 40 four-point Likert scale statements (20 related to trait anxiety and 20 related to state anxiety). Scores range from 40 to 160 with the higher score depicting a higher level of anxiety (Spielberger, 1983). This instrument has been interpreted in many languages and in a variety of populations. Due to the short 48-hour timeframe each cadet was enrolled in the study, internal consistency reliability could not be evaluated. However, the instrument was evaluated using a very similar population of college students (*n* 855) and military recruits (*n* 1,964) with Cronbach's alphas ranging from .91 to .95 (Table 6).

Table 6. Internal Consistency of State-Trait Anxiety Inventory

	College Students		**Military Recruits**	
	M (*n* 324)	F (*n* 531)	M (*n* 1,893)	F (*n* 71)
State (mean)	36.47	38.76	44.05	47.01
s.d.	10.02	11.95	12.18	14.42
Cronbach's α	.91	.93	.93	.95
Trait (mean)	38.30	40.40	37.64	40.03
s.d.	9.18	10.15	9.51	9.90
Cronbach's α	.90	.91	.89	.90

Paintball Perceived Stress Questionnaire

According to Cohen, Kamarck, and Mermelstein (1983), perceived stress is defined as a person's appraisal of an event as threatening or challenging. For the purpose of this study, a tool modeled after the 0-10 Pain Numeric Rating Scale was used to measure the cadets' perceived stress level at three intervals (before, during, and after the stressor). The 0-10 rating scale has been validated over the years as an effective way to measure one's perception of pain. Using the level 0 to represent no pain, the scale increases in value as the level of pain increases, with 10 representing the worst pain possible (Florida Agency for Health Care Administration, 2009). A descriptive correlational study published in 2006 assessed the reliability and validity for four different pain scales:

1. The Faces Pain Scale Revised (FPS-R)
2. The Verbal Descriptor Scale (VDS)
3. The Numeric Rating Scale (NRS)
4. The Iowa Pain Thermometer (IPT) (Ware, Epps, Herr, & Packard, 2006)

Using a sample of 68 cognitively intact and cognitively impaired older minorities (75% African-American [*n* = 50], 16% Hispanic [*n* = 11], and 10% Asian [*n* = 7]), participants were asked to rate their pain using the four methods (Ware et al., 2006). Spearman correlation coefficients were NRS (0.87), VDS (0.86), IPT (0.81), and FPS-R (0.76). Although the test-retest reliability coefficient showed FPS-R (0.89), IPT (0.82), VDS (0.79), and NRS (0.77), the NRS was the preferred method among both the cognitively intact (*n* = 12/36, 33%) and the college-educated (*n* =6/13, 46%) (Ware et al., 2006).

Using these same principles, at the completion of the exercise participants were asked to rank their level of stress using four questions:

1. What was your level of stress yesterday before the paintball exercise?
2. What was your level of stress during the paintball exercise?
3. What was your level of stress when you were placed in the leadership position?
4. What is your level of stress now? (Appendix L)

These four questions were asked at the end of the exercise, which provided a stress level value that was later correlated with the cardiovascular measures obtained prestressor, during the stressor, and poststressor. Since internal consistency reliability could not be evaluated, responses were compared to those in the STAI since both instruments evaluated “general” and “current” psychological states. These are discussed in Chapter 4.

Army Physical Fitness Test Score Sheet

Since a soldier’s level of fitness can greatly impact his or her combat readiness, a mandatory physical fitness assessment, called the APFT, is conducted twice a year (Department of the Army [DA], 1998). The test assesses soldiers in three events (push-ups, sit-ups, and two-mile run) to measure cardiorespiratory endurance, muscular strength, muscular endurance, and flexibility (DA, 1998). Based upon a soldier’s gender and age, the number of repetitions of sit-ups and push-ups in two minutes, along with the time it takes to complete a two-mile run, is calculated into a score ranging from 0-300 (0-100 points for each event) (DA, 1998). The higher the score, the better the level of fitness. For this study, the participant’s most recent APFT score within the last three months served as a level of fitness indicator (Appendix M).

Data Collection Procedure

Pilot Testing

After IRB approval and prior to the start of the study, a pilot study was conducted using three volunteers to:

1. Assess the feasibility of wearing the monitor
2. Assess the reliability and validity of the measures obtained from the monitor
3. Assess the usability of the software that analyzes the data from the monitor

The investigator along with two enlisted ROTC staff members wore the ambulatory blood pressure monitors for 72 hours. During that time, each person participated in 1-2 hours of paintball. Each person was then asked about his/her experience with the monitor to asses any issues that would pose difficulty once the study started. Measures were analyzed with the software provided and exported to an SPSS data file for a test analysis. Software and monitor questions were addressed with the President of Tiba Medical, and any logistical issues pertaining to the combat exercise were discussed with the ROTC staff.

Recruitment

After IRB approval, the investigator was scheduled to speak with the participants during one of their ROTC classes. The investigator wore civilian attire and introduced herself as a student of the College of Nursing. In conjunction with a written script (Appendix N), the investigator explained the purpose, procedures, and benefits of the study. Flyers were posted throughout the ROTC Department (Appendix B) along with a signup sheet and contact information. All recruitment was completed within 48 hours.

Data Collection

Once all of the participants were recruited, a *Recruitment Screening Tool* was distributed to assess the inclusion and exclusion criteria (Appendix O). A data collection timetable is noted in Table 7. On Day 1, a meeting was scheduled with all 60 cadets simultaneously to sign the consent, sign the paintball waiver (Appendix P), complete Form Y-2 of the *STAI*, and complete the *Participant Information Sheet*. Height, weight, and APFT scores were obtained from the most recent *APFT score card* (within the last three months) located in the ROTC file. Waist circumference was taken with a cloth tape measure in accordance with the military body fat analysis standards (DA, 2006).

Table 7. Data Collection Timetable

	Day 1	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**
Group A	1) Sign consent and waiver 2) Complete *Participant Information Sheet* 3) Complete *Trait Anxiety Inventory* 4) Obtain waist circumference	Prestressor Measures	Paintball Exercise (During Stressor Measures) 1) Complete *State Anxiety Inventory* 2) Complete *Paintball Perceived Stress Questionnaire*	Poststressor Measures Rotate Monitors		
Group B	1) Sign consent and waiver 2) Complete *Participant Information Sheet* 3) Complete *Trait Anxiety Inventory* 4) Obtain waist circumference			Prestressor Measures	Paintball Exercise (During Stressor Measures) 1) Complete *State Anxiety Inventory* 2) Complete *Paintball Perceived Stress Questionnaire*	Poststressor Measures

The sample was divided into two groups of 30 (Group A and Group B). On Day 2, the 30 participants (Group A) who were scheduled for the first rotation were fitted with ambulatory blood pressure monitors on their non-dominant arms and were given instructions on the proper wear and care of the monitor (Appendix Q). Monitors were set to obtain measures every 30 minutes during the waking hours and every 60 minutes when asleep. Participants were informed that they could engage in any activities that they would normally do, with the exception of strenuous exercise (e.g. running, weight training, etc.), and that the investigator may inquire about their activities if the monitor displayed questionable data. All information was kept confidential. Thorough instructions were also given on how to temporarily pause and remove the monitor for emergencies or activities such as bathing. In the event that the monitor needed to be removed for any reason during the 48 hours, it was stressed that the monitor had to be reapplied during the crucial data collection points (Table 8). Participants were given the investigator's telephone number and were instructed to call if there were any issues regarding the monitor.

Table 8. Crucial Data Collection Points Based on Data Collection Timetable

Day	**Time**
Day 2 (Group A) Day 4 (Group B) “Prestressor-Awake”	1400-1800 hrs
Day 2 (Group A) Day 4 (Group B) “Prestressor-Asleep”	While asleep
Day 3 (Group A) Day 5 (Group B) “Prestressor-Surge”	From time awakened for 2 hours
Day 3 (Group A) Day 5 (Group B) “During Stressor and Recovery”	1400-1900 hrs
Day 3 (Group A) Day 5 (Group B) “Poststressor-Awake”	1900-2300 hrs
Day 3 (Group A) Day 5 (Group B) “Poststressor-Asleep”	While asleep
Day 4 (Group A) Day 5 (Group B) “Poststressor-Surge”	From time awakened for 2 hours

On the Day 3, all monitors were removed and collected. While the participants were being fitted with the proper equipment and receiving their safety briefing from the Xtreme Paintball staff, the investigator downloaded the previous day’s data and exchanged all batteries. New blood pressure protocols were then uploaded and monitors redistributed to their assigned user. Monitors were set to obtain measures every 15 minutes for the duration of the exercise and automatically reverted back to the initial protocol (every 30 minutes while awake and every 60 minutes while asleep) once the recovery period was completed. Initially it was planned to monitor each participant as they rotated in the leadership position to assess the effect of an intensified stressor; however, due to the unpredictability of the exercise, accurate start and stop top times could not be established.

At the end of the exercise, dinner was served and participants were asked to complete Form Y-1 of the STAI while they relaxed for at least one hour. Before leaving the paintball site, participants were reminded not to remove the monitor until two hours after rising the next morning.

On Day 4, all 60 participants arrived to participate in a land navigation exercise. Monitors were collected and disinfected, data was downloaded, batteries were exchanged, and new protocol was uploaded for the next group of 30 participants. The same steps were taken as in Day 2; however, the participants wore the monitors during the two- to four-hour land navigation exercise.

On Day 5, Subjects in Group B were to follow the same protocol as in Day 3. However, due to severe weather and concern for safety, a 45-minute weapon familiarization exercise was used instead.

On Day 6, all monitors were collected and disinfected. Data were downloaded and saved to an encrypted portable hard drive.

Data Analysis Procedure

Demographic data were obtained from the *Participant Information Sheet*. Perceived stress scores were taken from the *Paintball Perceived Stress Questionnaire and* State and Trait Anxiety scores were taken from the *STAI forms Y-1 and Y-2*, which were calculated according to the *State-Trait Anxiety for Adults Manual, Instruction, and Scoring Guide* (Speilberger, 1983). Fitness scores, along with height and weight, were obtained from the most recent *APFT Score Card* on file in the ROTC Department, within the last three months. Body mass index was calculated using the standards and formula given by the Centers for Disease Control and Prevention (Centers for Disease Control and Prevention, 2009). Demographic information was described using frequencies and descriptive statistics and continuous variables were explored to determine normality. All data collected from the various instruments were de-identified.

Cardiovascular measures were downloaded directly from ambulatory blood pressure monitors into the *Hypertension Diagnostics Suite for Microsoft* software. Invalid measures as determined by the monitor were omitted. Measures were then logged into the Statistical Package for the Social Sciences (SPSS) version 18 (Chicago, Illinois). Using the SPSS software, data were reviewed for outliers, missing data, and errors. Questionable cardiovascular measures were compared to the original measures in *Hypertension Diagnostics Suite for Microsoft* software to ensure that there were no errors in data transcription. If measures were still questionable, they were further assessed for validity based on the participant's cardiovascular measure trend. Questionable measures were removed, listed on a separate tracking sheet and a new recoded variable was generated containing only valid measures, so that accurate analyses could be made. Cardiovascular measures obtained before the stressor served as the baseline measures to which all other measures were compared. Since all participants did not have the same number of measures throughout the data collection, mean values were used.

Since the time of each cardiovascular measure varied between participants, measures were logged to the nearest hour and/or half-hour mark. These measures were then placed into categories to reflect their time of day and the phase of exercise during which they were taken (Table 9). Waking and sleeping times were agreed upon at the initial interview with participants and were verified using the 3-axis of movement actigraphy reading provided by the ambulatory blood pressure monitor. To determine poststressor recovery, the lowest value during the one-hour recovery period was subtracted from the highest value during the stressor since the exercise involved intermitted bouts of stress that did not occur at the same time for each participant. Evening decline measures were determined by subtracting the lowest measure during the sleeping hours from the mean measure during the waking hours. Lastly, morning surge measures were determined by subtracting the mean sleeping measure from the highest morning measure during the first two hours of awakening.

Table 9. Cardiovascular Measures Timetable

Phase in the Cycle	**Subcategory of Measure**	**Time of Day**	**Activity**
Prestressor	Waking Measures	0800 – 2259 hrs	Group B participated in a four-hour land navigation exercise
	Sleeping Measures (also contains evening decline measures)	2300 - 0759 hrs	
	Morning Surge Measures	0800 – 1000 hrs	
During Stressor		1500 – 1859 hrs	Group A participated in a four-hour paintball combat exercise
		1800 – 1859 hrs	Group B participated in a one-hour paintball weapon familiarization exercise
Recovery		1900 - 2000 hrs	* Rest, no activity
Poststressor	Waking Measures	2000 – 2259 hrs	
	Sleeping Measures (also contains evening decline measures)	2300 – 0759 hrs (Group A)	
	Sleeping Measures (also contains evening decline measures)	2300 - 0429 (Group B)	
	Morning Surge Measure	0800 - 1000 (Group A)	
	Morning Surge Measures	0430 - 0600 (Group B)	

Research Questions and Statistical Tests

To answer the research questions, the following analyses were conducted. In all analyses, a *p* value of .05 was used as the level of significance.

Research Question 1a

What is a soldier's cardiovascular response under a simulated combat stressor when comparing the mean systolic blood pressures before, during, and after the stressor?

A one-way Analysis of Variance (ANOVA) was used to assess the variance of the mean systolic blood pressures between and within both groups before, during, and after the stressor. According to Mertler and Vannatta (2005), the assumptions for this test are:

1. The observations within each set of measures are independent of one another
2. The measures must be normal
3. The measures must have equal variance

For this test, statistical significance was determined by the *F* ratio (Mertler et al, 2005).

Research Question 1b

What is a soldier's cardiovascular response under a simulated combat stressor when comparing the mean diastolic blood pressures before, during, and after the stressor?

A one-way ANOVA was conducted to assess the variance of the mean diastolic blood pressures between and within both groups before, during, and after the stressor. The analysis was conducted in the same manner as research question 1a.

Research Question 1c

What is soldier's cardiovascular response under a simulated combat stressor when comparing the average mean arterial pressures before, during, and after the stressor?

A one-way ANOVA was conducted to assess the variance of the average mean arterial pressure between and within both groups before, during, and after the stressor. Analysis was conducted in the same manner as research questions 1a and 1b.

Research Question 1d

What is a soldier's cardiovascular response under a simulated combat stressor when assessing the number of mm Hg the systolic blood pressure declined after the stressor ceased?

A one-way ANOVA was conducted to assess the variance of the number of mm Hg the systolic blood pressure dropped between the highest measure during the stressor and the lowest measure during the recovery period, both between and within both groups. The analysis was conducted in the same manner as research questions 1a, 1b, and 1c.

Research Question 1e

What is a soldier's cardiovascular response under a simulated combat stressor when comparing pre and poststressor morning blood pressure surges?

A paired samples *t*-test was conducted to compare the prestressor and poststressor morning systolic blood pressure surges in both groups. According to Field (2009), assumptions for this analysis are:

1. The measures must be normally distributed
2. The data must be at least at the interval scale

3. There should be homogeneity of variance, and d) the values should be independent of one another.

Research Question 1f

What is a soldier's cardiovascular response under a simulated combat stressor when comparing the pre and poststressor evening blood pressure decline?

A paired-samples *t*-test was conducted to compare the pre and poststressor systolic blood pressure evening decline in both groups. The Analysis was conducted in the same manner as questions 1e.

Research Question 2

Which factors (individual differences, perceived stress/anxiety, or level of fitness) play the most significant role in a soldier's cardiovascular response under a simulated combat stressor?

A bivariate correlation was conducted to assess the relationships between personal characteristic (individual differences, anxiety/perceived stress scores, and level of fitness) and the pre, during, and post cardiovascular measures. According to Mertler et al., (2005), the assumptions are:

1. The variables are fixed
2. The variables are measures without error
3. The relationship are linear
4. There is homoscedasticity of the variables
5. The errors are normally distributed

To meet these assumptions, all non scale variables that were dichotomous were recoded.

Summary

Using a sample of 60 ROTC cadets, a repeated measure (three interval measures) design was used to assess the effect of a simulated combat stressor on cardiovascular response. IRB approval was given to protect the participants, identify risk and benefits, and to assure confidentiality. By having the cadets wear ambulatory blood pressure monitors for approximately 48 continuous hours, analyses can be made between the measure taken before, during, and after the stressor. Data were analyzed to determine if individual differences, perceived stress, and/or level of fitness played a role in their cardiovascular response. In order to answer the research questions, the statistical analyses were run using one-way ANOVAs, paired *t*-tests, independent samples *t*-tests, and bivariate correlations.

CHAPTER FOUR: RESULTS

This chapter summarizes the findings of the study. The study was conducted in March, 2010. Initially, the study was designed and powered to explore the cardiovascular measures of 60 participants. For data collection feasibility, the sample was divided into two groups of 30 cadets. Due to severe weather and cancellation of the paintball exercise for the second group (Group B), only the first group of 30 participants (Group A) was able to experience the full dose of the stressor. In collaboration with the dissertation committee, a decision was made to analyze data as a two-group quasi experiment design (one exposed to an intense physical stressor and the other exposed to as psychological and less intense physical stressor). Group A (n = 30), identified as the intervention group, represented the group that participated in the three- to four- hour intense paintball combat exercise while Group B (n = 30) represented the control group that participated in a land navigation exercise and a 45-minute paintball weapon familiarization exercise.

Since all participants did not have an equal number of measures, mean calculations were used instead. In the event that a calculation required a measure that was missing or deemed invalid, that participant's information was not included in the analysis, in turn changing the "*n*" in some of the tables.

Sample

Sixty cadets were enrolled in the study and were divided into two groups of 30 based on the company in which they were assigned. Descriptive analyses were conducted to assess group difference using crosstabulation with chi-square statistics for categorical data and independent samples t-test for scale data. Table 10 summarizes the demographic characteristics of participants. In Group A, the participants ranged from ages 18-33 years (m = 21.57 years) while

Group B participants ranged from ages 19-29 years (*m* = 20.57 years). Independent samples *t*-test with equal variances showed no group differences ($p > .05$) in regard to age ($t = 1.197$, $df = 58$, $p = .236$), BMI ($t = -.790$, $df = 53$, $p = .433$), and waist circumference ($t = .078$, $df = 58$, $p = .938$). Chi-square tests found no significant differences between the two groups ($p > .05$) in regard to gender (chi square (χ^2) = .000, $df = 1$, $p = 1.0$), race ($\chi^2 = 3.164$, $df = 3$, $p = .367$), ethnicity ($\chi^2 = .800$, $df = 1$, p = .371), or family history of HTN ($\chi^2 = 3.960$, $df = 2$, $p = .138$). In regard to deployment history, there was a significant difference between the groups ($\chi^2 = 4.286$, $df = 1$, $p = .038$), with Group A having four participants and Group B having none.

Table 10. Demographics of Participants

Demographics	Group A (Experimental) *n* = 30	Group B (Control) *n* = 30	P = Value
Age (mean)	21.57 (3.748 *s.d.*)	20.57 (2.622 *s.d.*)	$.236_b$
(min - max)	18-33	19-29	
Gender			1.00_a
Male	24 (80%)	24 (80%)	
Female	6 (20%)	6 (20%)	
Race			$.367_a$
Caucasian	20 (66%)	24 (80%)	
African-American	7 (24%)	3 (10%)	
Asian	3 (10%)	2 (6%)	
Other	0 (0%)	1 (3%)	
Ethnicity			$.371_a$
Hispanic or Latino	9 (30%)	6 (20%)	
Family History of HTN	14 (46%)	12 (40%)	$.138_a$
BMI (mean)	22.23 (3.55 *s.d.*)	25.34 (3.52 *s.d.)*	$.433_b$
(min-max)	21.16-30.86	18.97-33.14	
Waist Circumference (mean)	33.22 (3.14 *s.d.*)	33.15 (4.20 *s.d.)*	$.938_b$
(min-max)	26.25-39.75	26.00-43.00	
History of Deployment	4 (13%)	0 (0%)	**.038***$_a$

$_a$Chi Square test
$_b$Independent Samples t-test

Figure 6 shows the overall trend of the systolic and diastolic blood pressures of both groups before and after the stressor. The succeeding five research questions further assess the changes that occurred during and after the stressor as well as blood pressure recovery, evening blood pressure decline, and morning blood pressure surge, and their relationship to participants' personal characteristics.

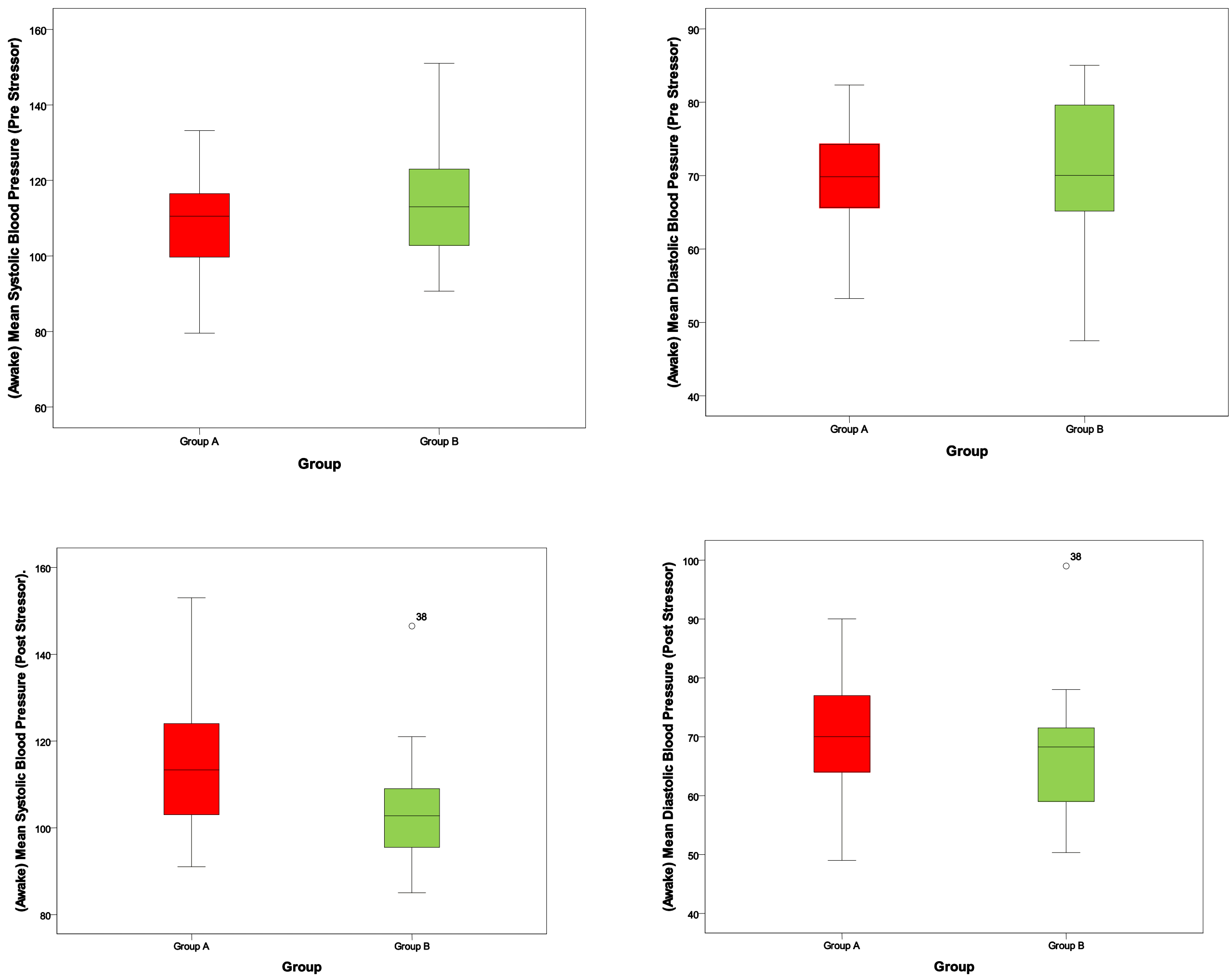


Figure 6. Comparison of Group Pre and Poststressor Blood Pressure

Research Question 1a

What is a soldier's cardiovascular response under a simulated combat stressor when comparing the mean systolic blood pressures before, during, and after the stressor?

A one-way ANOVA was conducted to compare the mean systolic blood pressure of both groups before, during, and after the paintball exercise. A significant difference was found in the mean waking poststressor systolic blood pressure ($F[1, 51] = 7.493$, $p = .009$). In other words, those who were exposed to the paintball exercise had a higher mean systolic blood pressure well after the exercise was over ($m = 113.76$, $sd = 15.509$) when compared to the group that did not participate in the exercise ($m = 102.98$, $sd = 13.087$) (Table 11).

Table 11. Systolic Blood Pressure Measures

		N	**Mean**	**Std. Deviation**	**Minimum**	**Maximum**	**Sig.**
(Waking) Mean Systolic Blood Pressure (Prestressor)	Group A	28	108.85	11.568	80	133	.098
	Group B	28	115.44	17.139	91	151	
	Total	56	112.15	14.864	80	151	
(Sleeping) Mean Systolic Blood Pressure (Prestressor)	Group A	28	97.62	8.511	84	125	.935
	Group B	29	97.45	6.939	83	111	
	Total	57	97.54	7.682	83	125	
Mean Systolic Blood Pressure During Stressor	Group A	22	111.6	20.939	70	143	.791
	Group B	28	112.99	15.924	70	141	
	Total	50	112.38	18.114	70	143	
(Waking) Mean Systolic Blood Pressure (Poststressor).	Group A	26	113.76	15.509	91	153	**.009***
	Group B	27	102.98	13.087	84	147	
	Total	53	108.27	15.194	84	153	
(Sleeping) Mean Systolic Blood Pressure (Poststressor)	Group A	28	96.98	8.208	78	118	.350
	Group B	27	94.91	8.067	79	111	
	Total	55	95.96	8.131	78	118	

Research Question 1b

What is a soldier's cardiovascular response under a simulated combat stressor when comparing the mean diastolic blood pressures before, during, and after the stressor?

A one-way ANOVA was conducted to compare the mean diastolic blood pressure both groups before, during, and after the stressor. No significant differences were noted between the two groups (Table 12).

Table 12. Diastolic Blood Pressure Measures

		N	**Mean**	**Std. Deviation**	**Minimum**	**Maximum**	**Sig.**
(Waking) Mean Diastolic Blood Pressure (Prestressor)	Group A	28	69.93	6.848	53	82	.239
	Group B	28	72.83	10.904	48	103	
	Total	56	71.38	9.139	48	103	
(Sleeping) Mean Diastolic Blood Pressure (Prestressor)	Group A	28	62.81	6.389	53	82	.593
	Group B	29	61.91	6.301	48	75	
	Total	57	62.35	6.304	48	82	
Mean Diastolic Blood Pressure During Stressor	Group A	21	80.23	17.557	52	119	.639
	Group B	28	78.22	12.340	58	113	
	Total	49	79.08	14.666	52	119	
(Waking) Mean Diastolic Blood Pressure (Poststressor)	Group A	26	69.59	9.577	49	90	.263
	Group B	27	66.54	10.022	50	99	
	Total	53	68.03	9.833	49	99	
(Sleeping) Mean Diastolic Blood Pressure (Poststressor)	Group A	28	62.32	6.534	49	84	.308
	Group B	27	60.7	5.001	51	69	
	Total	55	61.53	5.836	49	84	

Research Question 1c

What is a soldier's cardiovascular response under a simulated combat stressor when comparing the average mean arterial pressures before, during, and after the stressor?

A one-way ANOVA was conducted to compare the average mean arterial pressure of both groups before, during, and after the stressor. A significant difference was found in the average waking poststressor mean arterial pressure ($F[1, 51] = 4.212$, $p = .045$). Those who were exposed to the paintball exercise had a higher average mean arterial pressure poststressor (m = 85.22, sd = 15.416) when compared to the group that was not exposed (m = 77.43, sd = 12.083) (Table 13).

Table 13. Mean Arterial Blood Pressure Measures

		N	Mean	Std. Deviation	Minimum	Maximum	Sig.
(Waking) Average Mean Arterial Pressure (Prestressor)	Group A	28	82.85	10.473	61	108	.157
	Group B	28	87.01	11.188	65	107	
	Total	56	84.93	10.941	61	108	
(Sleeping) Average Mean Arterial Pressure (Prestressor)	Group A	28	72.39	7.945	62	99	.921
	Group B	29	72.59	6.978	56	90	
	Total	57	72.49	7.402	56	99	
Average Mean Arterial Pressure During Stressor	Group A	21	85.74	16.928	63	129	.753
	Group B	28	87.15	14.091	59	125	
	Total	49	86.55	15.218	59	129	
(Waking) Average Mean Arterial Pressure (Poststressor)	Group A	26	85.22	15.416	65	132	**.045***
	Group B	27	77.43	12.083	58	115	
	Total	53	81.25	14.238	58	132	
(Sleeping) Average Mean Arterial Pressure (Poststressor)	Group A	28	72.16	7.257	56	94	.446
	Group B	27	70.81	5.653	60	80	
	Total	55	71.5	6.495	56	94	

Research Question 1d

What is a soldier's cardiovascular response under a simulated combat stressor when assessing the number of mm Hg the systolic blood pressure declined after the stressor ceased?

A one-way ANOVA was conducted to compare the mean mm Hg that the systolic blood pressure declined after the exercise was completed. This decline was calculated by subtracting the lowest measure during the recovery phase from the highest measure during the stressor. Since many of the "during stressor" measures were invalid due to movement during measurement, only participants with valid measures were used to calculate systolic blood pressure recovery. Although Group B had a greater decline (21.50 mm Hg vs. 10.93 mm Hg), the differences were not statistically significant (*F*[1, 30] = 2.024, *p* = .165) (Table 14).

Table 14. Systolic Blood Pressure Recovery

	N	Mean	Std. Deviation	Minimum	Maximum	Sig.
Group A	14	10.93	24.326	-36	53	.165
Group B	18	21.50	17.737	-7	57	
Total	32	16.88	21.192	-36	57	

Research Question 1e

What is a soldier's cardiovascular response under a simulated combat stressor when comparing pre and poststressor morning blood pressure surge?

A paired-samples *t*-test was conducted to compare the mean prestressor morning systolic blood pressure surge to the mean poststressor morning systolic blood pressure surge between both groups. A significant difference was found only in Group B (*t*[21] = 2.243, *p* = .036) where the mean prestressor systolic blood pressure surge was 20.10 mm Hg (*sd* = 10.770) and mean poststressor systolic blood pressure surge was 10.96 mm Hg (*sd* = 14.818). When the groups were compared to one another, Group A had a greater systolic blood pressure morning surge (12.62 mm Hg vs. 10.96 mm Hg) the day after the paintball exercise, whereas Group B had a greater systolic blood pressure morning surge (20.10 mm Hg vs. 18.55 mm Hg) the day after the land navigation exercise (Table 15).

Table 15. Morning Systolic Blood Pressure Surge

		Mean	N	Std. Deviation	Sig (2-tailed)
Group A	Morning Surge Systolic Blood Pressure (Prestressor)	18.55	25	20.153	.181
	Morning Surge Systolic Blood Pressure (Poststressor)	12.62	25	16.106	
Group B	Morning Surge Systolic Blood Pressure (Prestressor)	20.10	22	10.770	.036
	Morning Surge Systolic Blood Pressure (Poststressor)	10.96	22	14.818	

The same analysis was conducted to compare the pre and poststressor diastolic blood pressure morning surges and again found that there was a significant difference in Group B ($t[21] = 2.363$, $p = .028$). The mean prestressor diastolic blood pressure morning surge was 17.62 mm Hg (*sd* = 12.372) and the poststressor diastolic blood pressure morning surge was 8.31 mm Hg (*sd* = 15.295) (Table 16).

Table 16. Morning Diastolic Blood Pressure Surge

		Mean	N	Std. Deviation	Std. Error Mean	Sig (2-tailed)
Group A	Morning Surge Diastolic Blood Pressure (Prestressor)	12.60	25	15.935	3.187	.406
	Morning Surge Diastolic Blood Pressure (Poststressor)	9.65	25	12.014	2.403	
Group B	Morning Surge Diastolic Blood Pressure (Prestressor)	17.62	22	12.372	2.638	.028
	Morning Surge Diastolic Blood Pressure (Poststressor)	8.31	22	15.295	3.261	

Research Question 1f

What is a soldier's cardiovascular response under a simulated combat stressor when comparing the pre and poststressor evening blood pressure decline?

A paired-samples *t*-test was conducted to compare the pre and poststressor systolic blood pressure evening decline in each group. A significant difference was found only in Group B ($t[23] = 3.080$, $p = .005$), where the mean prestressor systolic blood pressure evening decline was 18.93 ($sd = 16.484$) and the mean poststressor systolic blood pressure evening decline was 5.98 ($sd = 9.555$) (Table 17).

Table 17. Evening Systolic Blood Pressure Decline

		Mean	N	Std. Deviation	Sig (2-tailed)
Group A	Evening Decline Systolic Blood Pressure (Prestressor)	12.36	23	10.925	.319
	Evening Decline Systolic Blood Pressure (Poststressor).	16.21	23	14.412	
Group B	Evening Decline Systolic Blood Pressure (Prestressor).	18.93	24	16.484	.005
	Evening Decline Systolic Blood Pressure (Poststressor).	5.98	24	9.555	

The same analysis was computed to compare the pre and poststressor DBP evening decline and found that there were no significant differences in either group: Group A (m = -217, sd = 13.583) (t[22] = -.077, p = .940) and Group B (m = 4.667, sd = 13.539) (t[23] = 1.689, p = .105) (Table 18).

Table 18. Evening Diastolic Blood Pressure Decline

		Mean	N	Std. Deviation	Sig. (2-tailed)
Group A	Evening Decline Diastolic Blood Pressure (Prestressor).	17.30	23	7.793	.940
	Evening Decline Diastolic Blood Pressure (Poststressor)	17.51	23	9.655	
Group B	Evening Decline Diastolic Blood Pressure (Prestressor)	18.38	24	10.480	.105
	Evening Decline Diastolic Blood Pressure (Poststressor)	13.71	24	10.946	

Research Question 2

Which factors (individual differences, anxiety/perceived stress, or level of fitness) play the most significant role in a soldier's cardiovascular response under a simulated combat stressor?

Correlational statistics were conducted to assess the relationship between the participants' characteristics and the various cardiovascular measures. Due the sample size, a multiple regression analysis could not be computed to determine the extent of those relationships. For age, BMI, waist circumference, APFT scores, and anxiety scores, a Pearson's correlation coefficient was used. In regard to gender, race, ethnicity, family history of hypertension, deployment history, and perceived stress, the variables were coded dichotomously so that a Spearman rho correlation coefficient could be run. All pre, during, and poststressor correlations are noted in Tables 19, 20, and 21, and data are discussed individually in the succeeding paragraphs. Variables that showed significant correlation ($p < .05$) are noted by an asterisk.

Table 19. Relationship between Characteristics and "Prestressor" Cardiovascular Measures

	A.M. surge SBP	**A.M. surge DBP**	**Mean (waking) SBP**	**Mean (waking) DBP**	**Mean (waking) MAP**	**Mean (waking) Pulse Rate**	**Mean (sleeping) SBP**	**Mean (sleeping) DBP**	**Mean (sleeping) MAP**	**Mean (sleeping) Pulse Rate**	**P.M. Decline**
					Individual Differences						
Gender (Female)	-.054	-.127	-.065	-.113	-.148	**.440***	.136	.216	.196	**.345***	-.128
Age	-.140	-.048	-.054	-.048	-.028	-.033	-.199	.175	.161	-.053	-.138
Race (Caucasian)	.041	.170	-.115	-029	.020	-.181	**-.343***	-.318	-.400	-.140	.077
Race (Afr. Amer.)	-.192	**-.345***	-.038	-.177	-.189	.042	**.360***	**.408***	**.395***	.108	-.181
Race (Asian)	.140	.088	.128	.103	.141	.203	.057	.017	.141	.132	.006
Race (Other)	.171	.201	.225	.192	.175	.058	.028	-.102	-.061	-.114	.213
Ethnicity (Hisp.)	.016	.020	.010	.071	.028	.027	-.105	-.092	-.116	.115	.069
BMI	.073	.163	-.051	.110	.019	-.238	.047	.201	.146	.009	-.093
Waist Circumference	**.272***	**.355***	.025	.130	.082	-.219	-.208	-.157	-.175	-.020	.120
Family History of HTN	-.042	.041	.178	.143	.167	.234	-.007	-.100	.-.036	.134	.160
History of Previous Deployment	.132	-.024	.028	-.097	-.060	-.030	.071	.094	.106	-.008	-.133
					Perceived Stress and Anxiety						
State Anxiety	.035	-.004	-.123	-.029	-.020	-.045	.038	.156	.147	.138	-.201
Trait Anxiety	-.047	-.067	-.081	-.137	-.082	.080	.018	.111	.121	.188	-.147
Perceived Stress (before the stressor)	.076	.002	-.176	.061	-.028	.122	-.151	-.034	.000	.171	-.108
					Perceived Stress and Anxiety						

	A.M. surge SBP	A.M. surge DBP	Mean (waking) SBP	Mean (waking) DBP	Mean (waking) MAP	Mean (waking) Pulse Rate	Mean (sleeping) SBP	Mean (sleeping) DBP	Mean (sleeping) MAP	Mean (sleeping) Pulse Rate	P.M. Decline
Perceived Stress (during the stressor)	.036	-.032	.158	.111	.150	.111	.090	.005	.053	.207	.183
Perceived Stress (after the stressor)	.010	-.102	**-.310***	-.142	-.086	.006	-.208	-.095	-.174	.023	-.261
Level of Fitness											
APFT Total Score	-.119	-.147	.143	-.006	.151	-.243	.124	.048	.013	**-.397***	.132
APFT Run Score	-.005	-.096	.255	-.086	.204	-.097	.249	.135	.124	**-.286***	.147

Table 20. Relationship Between Characteristics and "During Stressor" Cardiovascular Measures

	Mean SBP (during stressor	**Mean DBP (during stressor)**	**Mean MAP (during stressor)**	**Mean Pulse Rate (during stressor)**	**Poststressor SBP Recovery**
			Individual Differences		
Gender (Female)	-.192	-.189	-.169	**.300***	.252
Age	**.296***	**.343***	**.371***	.050	.182
Race (Caucasian)	.248	**.319***	**.347***	.162	.289
Race (Afr. Amer.)	-219	-264	-.252	-.161	**-.385***
Race (Asian)	-.079	-.217	-.214	-.120	-.091
Race (Other)	-.050	.087	-.036	.129	.058
Ethnicity	.012	.180	.050	**.368***	-.050
BMI	**.343***	**.294***	**.323***	**.147***	.099
Waist Circumference	**.397***	**.387***	**.399***	.030	.159
Family History of HTN	-.222	.025	-.201	.079	-.295
History of Previous Deployment	-.066	-.132	-.253	.196	.221
			Perceived Stress and Anxiety		
State Anxiety	-.141	-.178	-.158	-.042	-.104
Trait Anxiety	-.094	.080	-.093	.026	**-.378***
Perceived Stress (before the stressor)	-.185	-.262	-.259	-.046	.018
Perceived Stress (during the stressor)	-.042	-.206	.-.140	-.087	.091
Perceived Stress (after the stressor)	-.136	-.164	-.137	-.214	-.028
			Level of Fitness		
APFT Total Score	.102	.107	.101	-.217	-.001
APFT Run Score	.036	.093	.062	-.101	-.013

Table 21. Relationship between Characteristics and "Poststressor" Cardiovascular Measures

	A.M. surge SBP	**A.M. surge DBP**	**Mean (waking) SBP**	**Mean (waking) DBP**	**Mean (waking) MAP**	**Mean (waking) Pulse Rate**	**Mean (sleeping) SBP**	**Mean (sleeping) DBP**	**Mean (sleeping) MAP**	**Mean (sleeping) Pulse Rate**	**P.M. Decline**
Individual Differences											
Gender (Female)	.075	.174	-.091	-.174	-.097	-.019	-.168	-.168	-.168	**.374***	.003
Age	**.376***	**.301***	-.086	-.020	-.063	.179	.107	.141	.168	.112	-.126
Race (Caucasian)	-.077	-.137	-.125	.076	-.136	.038	-.157	-.126	-.168	.172	-.069
Race (Afr. Amer.)	.043	.147	.110	.019	.129	.022	.079	.183	.183	.228	.077
Race (Asian)	.118	.042	.146	-.042	.141	-.032	.127	.26	.064	-.056	.096
Race (Other)	-.119	-.035	-.200	-.204	-.204	-.113	030	-.141	-.081	.064	-.187
Ethnicity (Hisp.)	-.313	-.175	.063	-.067	-.077	**.320***	.137	.016	.050	.201	-.002
BMI	**.339***	**.335***	-.109	-.017	-.158	.207	-.121	.015	.017	-.025	-.079
Waist Circumference	.151	.189	-.109	-.008	-.164	.064	-.025	.124	.133	.035	-.135
Family History of HTN	-.131	.067	-.006	-.017	-.046	.213	.243	.008	.174	.253	**.302***
History of Previous Deployment	-.143	-.107	**.371***	.128	**.357***	.086	.207	.128	.128	.168	-.033
Perceived Stress and Anxiety											
State Anxiety	-.053	-.052	.260	.233	.296	.073	**-.274***	-.257	-.250	-.030	.403
Trait Anxiety	.074	.139	.136	-.040	.132	.003	.063	.034	.115	.109	.112
Perceived Stress (before the stressor)	-.072	.124	-.074	-.177	-.202	-.056	-.165	-.167	-.160	-.039	.004

	A.M. surge SBP	**A.M. surge DBP**	**Mean (waking) SBP**	**Mean (waking) DBP**	**Mean (waking) MAP**	**Mean (waking) Pulse Rate**	**Mean (sleeping) SBP**	**Mean (sleeping) DBP**	**Mean (sleeping) MAP**	**Mean (sleeping) Pulse Rate**	**P.M. Decline**
Perceived Stress and Anxiety											
Perceived Stress (during the stressor)	**-.322***	-.209	-.095	-.040	-.046	-.025	-.097	-.101	-.091	-.027	-.015
Perceived Stress (after the stressor)	-.151	.037	-.183	-.107	-.041	-.207	-.177	-.236	-.216	-.078	-.044
Level of Fitness											
APFT Total Score	-.080	.057	-.199	.136	-.127	.001	.065	-.174	.103	**-.505***	-.202
APFT Run Score	.019	.081	-215	.082	-.133	.046	.240	-.068	.022	**-.374***	-.287

Individual Differences

Age, Body Mass Index, and Waist Circumference

A Pearson correlation coefficient was computed to assess the relationship between age, BMI, and waist circumference with the various cardiovascular measures. Analysis showed a positive relationship between age (r = .296, p = .037), BMI (r = .343, p = .018), and waist circumference (r =.397, p = .004) with the mean systolic blood pressure during the stressor. There was also a positive relationship between age (r=.343, p = .016), BMI (r =.294, p = .047), and waist circumference (r =.387, p = .006) with the mean diastolic blood pressure during the stressor. Poststressor systolic and diastolic morning blood pressure surges were positively correlated with age (r = .376, p = .007 and r = .301, p = .003, respectively) and BMI (r = .339, p =.021 and .335, p = .023). However, prestressor systolic and diastolic morning blood pressure surges were only positively correlated with waist circumference (r = .272, p = .044 and r = .355, p = .008) (Tables 19, 20, and 21).

Gender

A Spearman rho correlation was conducted to assess the relationship between gender and the cardiovascular measures. Analysis showed a consistent positive relationship between the female gender and waking pulse rate prestressor (r =.440, p = .001), sleeping pulse rate prestressor (r = .345, p = .009), pulse rate during the stressor (r =.300, p = .035), and sleeping pulse rate poststressor (r= .374, p = .005). When further analyzed using an independent samples t-test, females consistently had higher pulse rates than males in their waking pulse rate prestressor (77.66 vs. 65.73) (t[54] = -3.311, p = .002), sleeping pulse rate prestressor (63.37 vs. 56.37) (t[55] = -2.438, p = .018), pulse rate during the stressor (79.21 vs. 66.38) (t[48] = -2.110, *p* = .040), and sleeping pulse rate poststressor (62.46 vs. 55.54) (*t*[53] = - 2.452 , p = .018) (Tables 19, 20, and 21).

Race

In regard to race, variables were coded so that each race was compared individually against the rest of the sample. A Spearman rho correlation coefficient was used to assess the relationship between each race and the various cardiovascular measures. Caucasians and African-Americans were the only groups that showed significant relationships.

There was a positive relationship between Caucasians and diastolic blood pressure during the stressor (*r* = .319, *p* = .026) as well as mean arterial pressure during the stressor (*r* =.347. *p* = .014). African-Americans, on the other hand, showed a negative relationship to diastolic blood pressure morning surge before the stressor (*r* = .345, *p* = .010) and systolic blood pressure recovery immediately after the stressor (*r* = -.385, *p* = .030). Interestingly, there was an inverse relation between Caucasians and African-Americans in regard to the sleeping measures during the prestressor period. Caucasians had a negative relationship sleeping systolic blood prestressor (*r* = -.343, *p* = .009), sleeping diastolic blood pressure prestressor (*r* = -.318, *p* = .016), and sleeping mean arterial pressure prestressor (*r* = -.400, *p* = .002), whereas African-Americans had a positive relationship with sleeping systolic blood prestressor (*r* = .360, *p* = .006), sleeping diastolic blood pressure prestressor (*r* = .408, *p* = .002), and sleeping mean arterial pressure prestressor (*r* = .395, *p* = .002) (Tables 19, 20, and 21).

Ethnicity

A Spearman rho correlation coefficient was computed and found a positive relationship between Hispanics and pulse rates during stressor (*r* = .368, *p* = .009), during recovery (*r* = .553, *p* = .001), and after the stressor (*r* =.320, *p* = .019). An independent samples *t*-test further showed that those of Hispanic descent had a significantly higher pulse during the stressor (79.63 vs. 64.74) (*t*[48] = 2.794, *p* = .007), during recovery (85.55 vs. 67.35) (*t*[33] = 2.932, *p* = .006), and after the stressor (72.38 vs. 64.06) (*t*[51] = 2.454, *p* = .018) when compared to non-Hispanics. Analyses also showed that there was a negative relationship between Hispanics and morning systolic blood pressure surge poststressor (*r* = -.313, *p* = .027) when compared to non-Hispanics (3.70 vs. 14.39) (*t*[48] -2.269, *p* = .028) (Tables 19, 20, and 21).

Family History

A Spearman rho correlation coefficient was used to assess the relationship between family history of hypertension and the various cardiovascular measures, which found no significant relationship with any of the measures before, during, or after the stressor.

History of Previous Deployment

A Spearman rho correlation coefficient was conducted to assess the relationship between those who had a deployment history and the various cardiovascular measures, and found a significant relationship with waking systolic blood pressure after the stressor (*r* = .371, *p* = .006). Further analysis using an independent samples *t*-test showed that those with a deployment history had a higher waking systolic blood pressures after the stressor (131.72 vs. 106.34) (*t*[51] = 3.588, *p*= .001) when compared to those who have never deployed. Higher evening systolic blood pressure decline after the stressor also correlated with history of previous deployment (*r* = .302, p = .031). Further analysis showed that those with a deployment history had a greater systolic blood pressure decline (31.05 vs. 9.90) (*t*[49] = 2.607, *p* = .012) when compared to those who have never deployed (Tables 19, 20, and 21).

Perceived Stress and Anxiety

Perceived Stress

To help validate the Likert-type Paintball Perceived Stress questionnaire, state and trait anxiety scores were correlated with the perceived stress scores. A Spearman correlation coefficient was conducted and found a positive relationship between trait anxiety and perceived stress levels before (r = .312, p =.018) and after (r = .379, p =.004) the paintball exercise. State anxiety positively correlated with perceived stress during the exercise (r = .450, p = .000). This showed that the Paintball Perceived Stress questionnaire was capable of measuring the same transitory and general level of psychological stress as the State-Trait Anxiety Inventory (Table 22).

Table 22. Relationship between STAI Scores and Paintball Perceived Stress Scores

	Perceived Stress Prestressor	**Perceived Stress During Stressor**	**Perceived Stress Poststressor**
Trait Anxiety Score	**.312***	-.080	**.379***
State Anxiety Score	.235	**.450***	.129

State and Trait Anxiety

An independent samples t-test was conducted to assess the state and trait anxiety scores for both groups. The results showed that there was no significant difference with Group A having a mean trait anxiety score of 33.72 (sd = 7.294) and Group B having a mean score of 33.43 (sd = 6.989) (t[55] = .156, p = .877). As for state anxiety, Group A had a mean score of 35.57 and

Group B had a mean score of 40.33, once again showing no significant difference (*t*[58] = -1.640, *p* = .106) (Table 23).

Table 23. State-Trait Anxiety Scores by Group

	Mean	**Std. Deviation**	**Min-Max**	***t***	***p* (two-tailed)**
Trait Anxiety (STAI Form Y-2)				.156	.877
Group A	33.72	7.294	24-52		
Group B	33.43	6.989	21-54		
State Anxiety (STAI Form Y-1)				-1.649	.106
Group A	35.57	11.967	22-62		
Group B	40.33	10.492	23-69		

A Pearson's correlation coefficient was conducted and found that higher state anxiety positively correlated with systolic blood pressure after the stressor (*r* = .403, *p*= .003) and diastolic blood pressure evening decline (*r* =.365, *p*= .008). As for trait anxiety, there was a negative relationship correlation with the systolic blood pressure recovery (*r* = -.378, *p*= .039). In other words, the higher the trait anxiety, the smaller the variance between the systolic blood pressure during the stressor and the recovery systolic blood pressure (Tables 19, 20, and 21).

State and trait anxiety scores were also assessed between genders using an independent samples *t*-test and found that females had a significantly higher mean state anxiety score (*m* =46.17, *sd* = 14.409) when compared to males (*m* = 35.90, *sd* = 9.665) (*t*[58] = -2.967, *p* = .004) (Table 24). Although not statistically significant, females also had a higher mean trait anxiety score (*m* = 36.91, *sd* = 10.084) when compared to males (*m* = 32.78, *sd* = 6.040) (*t*[55] = -1.768, *p* = .083) (Table 24).

Table 24. State-Trait Anxiety Scores by Gender

	Mean	Std. Deviation	Min-Max	*t*	*p* (two-tailed)
Trait Anxiety (STAI Form Y-2)				-1.768	.083
Males	32.78	6.040	21-52		
Females	36.91	10.084	23-54		
State Anxiety (STAI Form Y-1)				-2.967	**.004***
Males	35.90	9.665	20-58		
Females	46.17	14.409	28-68		

Perceived Stress

The Paintball Perceived Stress Questionnaire was used to determine the participants' level of perceived stress before, during, and after the exercise. An independent samples *t*-test was conducted to assess if there was a difference between both groups and found that both groups scored similarly before ($t[58] = -1.341$, $p = .185$) and after ($t[58] = -.402$, $p = .689$) the stressor. However, Group B, who was not exposed to the combat exercise and only exposed to a weapon familiarization exercise, actually had a significantly higher perceived stress score during the stressor (6.20 vs. 4.93) than Group A ($t[58] = -2.379$, $p = .021$) (Table 25).

Table 25. Perceived Stress Scores by Group

	Mean	**Std Deviation**	**Min-Max**	***t***	***P* (two-tailed)**
Perceived Stress Before Stressor				-1.341	.185
Group A	2.23	1.870	0-7		
Group B	2.97	2.341	0-8		
Perceived Stress During Stressor				-2.379	**.021***
Group A	4.93	2.318	0-8		
Group B	6.20	1.769	3-10		
Perceived Stress After Stressor				-.402	.689
Group A	1.70	1.745	0-5		
Group B	1.90	2.090	0-7		

A Spearman correlation *rho* correlation coefficient was conducted and found that there was a negative relationship between perceived stress level during the combat exercise and poststressor systolic blood pressure morning surge (r = -.322, p= .023). The analysis also showed that perceived stress level during the stressor negatively correlated with systolic blood pressure recovery (r = -.445, p = 012), which again showed that the higher the anxiety or perceived stress during the exercise, the smaller the variance between the systolic blood pressure during the stressor and the recovery systolic blood pressure (Tables 19, 20, and 21).

Perceived stress scores were also assessed between genders using an independent samples *t*-test. Females consistently had higher perceived stress scores when compared to males before the stressor (3.33 versus 2.24, respectively), during the stressor (6.33 versus 5.38, respectively), and after the stressor (1.92 versus 1.77, respectively). Only the during stressor measures were statistically significant (t[60] = -2.432, p = .022) (Table 26).

Table 26. Perceived Stress Scores by Gender

	Mean	**Std Deviation**	**Min-Max**	***t***	***p* (two-tailed)**
Perceive Stress Before Stressor				-1.341	.185
Males	2.42	2.061	0-8		
Females	3.33	2.348	0-7		
Perceive Stress During Stressor				-2.432	**.022***
Males	5.38	2.237	0-10		
Females	6.33	1.557	3-9		
Perceive Stress After Stressor				-.234	.815
Males	1.77	1.992	0-7		
Females	1.92	1.621	0-5		

Level of Fitness

Army Physical Fitness Test

Finally, the participants' level of fitness was determined by the total score of their most recent APFT. Cardio-respiratory fitness was determined by the APFT run score. A Pearson correlation coefficient was conducted to assess the relationship between APFT scores and cardiovascular response, which found that a high APFT total score and high APFT run score negatively correlated pulse rates during the sleeping hours both prestressor (r = -.397, p = .004 and -.047, p = .047) and poststressor (r = -.505, p = .000 and -.377, p = .008) (Tables 19, 20, and 21).

Retrospective Power Analysis

After all data were analyzed, a retrospective power analysis was conducted to assess the observed power for each of the variables. Due to the unanticipated splitting of the sample into two groups, statistical power was lowered in all of the variables with the exception of five: recovery pulse rate (.872, p = .003), poststressor waking systolic blood pressure (.766, p = .009), poststressor pulse rate (.642, p= .022), poststressor waking mean arterial pressure (.521, p = 045), and poststressor evening systolic blood pressure decline (.593, p= 030) (Table 27).

Table 27. Retrospective Power Analysis

Variable	Observed Power	Sig	Partial eta squared	Group A (mean)	*n*	Group B (mean)	*n*
Prestressor Measures							
(waking) SBP	.381	.098	.050	108.85	28	115.44	28
(waking) DBP	.215	.239	.026	69.93	28	72.83	28
(waking) PR	.072	.659	.004	67.57	28	69.00	28
(waking) MAP	.292	.157	.037	87.01	28	87.01	28
(sleeping) SBP	.051	.935	.000	97.62	28	97.45	29
(sleeping) DBP	.083	.593	.005	62.81	28	61.91	29
(sleeping) PR	.051	.946	.000	57.80	28	57.64	29
(sleeping) MAP	.051	.921	.000	72.39	28	72.59	29
Morning SBP surge	.052	.901	.000	18.41	28	17.83	27
Morning DBP surge	.254	.193	.032	11.65	28	17.09	27
Evening SBP decline	.334	.125	.046	12.46	26	18.52	27
Evening DBP decline	.176	.303	.021	8.09	26	11.25	27
During Stressor Measures							
SBP	.058	.791	.001	111.6	22	112.99	28
DBP	.075	.639	.005	80.23	21	78.22	28
PR	.231	.219	.031	73.00	21	66.46	29
MAP	.061	.753	.002	85.74	21	87.15	28
# of mm Hg SBP dec.	.281	.165	.063	10.93	14	24.50	18
Recovery Measures							
SBP	.444	.070	.096	111.53	17	105.67	18
DBP	.139	.379	.024	74.09	17	70.58	18
PR	.872	**.003***	.003	79.88	17	64.81	18
MAP	.138	.383	.023	88.47	17	84.31	18
Poststressor Measures							
(waking) SBP	.766	**.009***	.128	113.76	26	102.98	27
(waking) DBP	.199	.263	.025	69.59	26	66.54	27
(waking) PR	.642	**.022***	.099	69.88	26	62.77	27
(waking) MAP	.521	**.045***	.076	85.22	26	77.43	27
(sleeping) SBP	.152	0.35	.016	96.98	28	94.91	27
(sleeping) DBP	.173	.308	.020	62.32	28	60.70	27
(sleeping) PR	.369	.104	.049	59.00	28	55.03	27
(sleeping) MAP	.117	.446	.011	72.16	28	70.81	27
Morning SBP surge	.094	.533	.008	12.92	26	10.2	24
Morning DBP surge	.097	.522	.009	10.37	26	7.90	24
Evening SBP decline	.593	**.030***	093	16.42	26	6.50	25
Evening DBP decline	.111	.465	.001	7.56	26	5.28	25

Summary

Numerous analyses were computed using one-way ANOVAs and Pearson and Spearman rho correlation coefficients, as well as independent and paired sample *t*-tests. Although a retrospective power analysis showed that the unanticipated splitting of the sample into two separate groups lowered statistical power, findings showed that age, female gender, African-American descent, BMI, waist circumference, previous deployment history, level of fitness, and the psychological stress state during a stressor played significant roles in the cardiovascular response before, during, and after a stressor. These findings are discussed individually in Chapter 5. A retrospective power analysis found that splitting the sample into two groups reduced the power for the various cardiovascular measures with the exception of recovery pulse rate, poststressor waking systolic blood pressure, poststressor waking pulse rate, poststressor waking mean arterial pressure, and poststressor evening systolic blood pressure decline.

CHAPTER FIVE: DISCUSSION

The results of this study point to seven key elements that have been consistently associated with cardiovascular health. These are:

1. Systolic blood variability
2. The residual effects of the stress response
3. Special consideration to the female population
4. The inevitable impact of age
5. The increased risk in the African American population
6. Waist circumference over BMI
7. The importance of cardiorespiratory fitness

Research Question 1a-1f

Research questions 1a-1f addressed changes that occurred in systolic/diastolic blood pressures and mean arterial pressure before, during, and after the stressor. Of these indices, systolic blood pressure had the most significant response, showing the highest variability in the various stages.

Systolic Blood Pressure versus Diastolic Blood Pressure

When comparing systolic and diastolic blood pressure of both groups after the stressor and regardless of the stressor, the difference in systolic blood pressure between the groups was 10.78 mm Hg, whereas the diastolic blood pressure difference was only 3.05 mm Hg. Of all of the cardiovascular measures, systolic blood pressure appeared to be the most dynamic and consistent measure for demonstrating the effect of the stress response. In 1977, guidelines to detect and treat high blood pressure were based solely on diastolic blood pressure readings since it was found that arteries thicken over time, in turn causing a decrease in vessel elasticity (Tin, Beevers, & Lip, 2002). It was not until 1993 that systolic blood pressure was incorporated into staging of blood pressure, when isolated systolic hypertension posed a strong and independent risk for cardiovascular mortality (Tin et al, 2002). When comparing theses two measures, systolic blood pressure consistently tends to rise throughout the lifespan, in contrast to diastolic blood pressure, which rises until about age 50 then levels off (DH&HS, 2004; Burt, Whelton, Roccella, Brown, Cutler, Higgins et al., 1995). Closer attention now is given to systolic blood pressure because it was found that poor systolic blood pressure control was mainly responsible for the low rates of overall blood pressure control (DH&HS, 2004). Since diastolic blood pressure represents the pressure within the vessels when the ventricles are at rest, fluid volume within the vessels, and not the stress response, may be the main reason for its variation. Systolic blood pressure, on the other hand, is more sensitive to the influences of the sympathetic nervous system and should be monitored more closely. For every mmHg that the blood pressure rises, an additional 0.02– 0.03 mm of carotid artery thickness develops (Kamarck, Everson, Kaplan, Manuck, Jennings, Salonen, et al., 1997; Forcier, Stroud, & Papandonatos, 2006). This increase in thickness in turn creates more pressure in vessels, causing a high blood pressure cyclic effect.

Residual Effects of the Stress Response

In this study, both groups were exposed to some form of a stressor. Group A was exposed only to an intense physical stressor while Group B was exposed to a psychological stressor one day and a less intense physical stressor the next day. Regardless of the intensity or duration of the stressor, there were some residual effects on the cardiovascular system even hours after the stressor ceased. When comparing the number of mm Hg that the systolic blood pressure dropped one hour after the physical stressor had ceased, participants in Group B, who were exposed to a less intense stressor, had a mean systolic blood pressure that dropped 21.50 mm Hg, while Group A only dropped 10.93 mm Hg. This residual effect could still be seen several hours later where Group A, who had the longer and more intense stressor, had a mean blood pressure that remained 9% higher than Group B. Most studies assessing cardiovascular recovery have focused on the first five to 10 minutes poststressor. This process may provide good information regarding cardiovascular conditioning; however, when assessing the residual effects of the stress response, at least 40 to 45 minutes may be necessary (Steptoe, 2006). Another influencing factor on systolic blood pressure recovery was the participant's Trait Anxiety score. Higher trait anxiety scores were negatively associated (-.378, = p <.05) with systolic blood pressure recovery (Table 20). In other words, those who considered themselves more anxious most of the time continued to have higher blood pressures, even an hour after the stressor ceased, than those who consider themselves less anxious most of the time.

When comparing pre and poststressor morning blood pressure surge and evening blood pressure decline, Group B showed the most significant difference (Tables 16 and 17). Further assessment showed that a psychological stressor, such as land navigation, was enough to elicit a stress response comparable to the intense physical stressor of paintball. When both stressors were further assessed, it was found that land navigation was a solo task performance whereas paintball was a group task performance. The psychological stress of performing a combat task alone, although not physically challenging, may in fact be just as stressful as an intense physical combat performance in group.

In regard to the blood pressure decrease during sleeping hours, pre and poststressor evening blood pressures were compared and found that stress exposure elicited a greater blood pressure decline; however, this factor is most likely attributed to the wide range that the blood pressure fluctuated between baseline and stress measures. Small residual effects were also seen in the mornings following the two different stressors. When assessing the number of mm Hg the blood pressure rose the morning following the stressor, a difference was noted between the stressed and non-stressed group during paintball (12.62 mm Hg SBP/9.65 mm Hg DBP vs. 10.96 mm Hg SPB/8.31 mm Hg DBP), as well as the stressed and non-stressed group and land navigation exercise (20.10 mm Hg SBP/17.62 mm Hg DBP vs. 18.55 mm Hg SBP/12.60 mm Hg DBP). Although these were small differences, attention is still warranted to the morning blood pressure measures since catecholamine levels as well as the renin-angiotensis–aldosterone system follow a similar circadian pattern (Patel, Wong, & Arora, 2008). As discussed earlier, these factors greatly contribute to blood pressure. When these factors are combined with the increased platelet aggregation and increased vascular spasm, particularly between the hours of six a.m. and noon, this makes the cardiovascular system more vulnerable to such things as a myocardial infarction (Kario et al, 2003).

Although this residual effect on the cardiovascular system may be attributed to the tri-system network of the neurological, endocrine, and renal mechanisms that were activated through an external force such as a stressor, it may be the internal forces (e.g., anxiety, perceived stress, etc.) that have a bigger influence on how long the effect remains. In this study, state anxiety positively correlated with the mean waking arterial pressure after the stressor (Table 21), while trait anxiety negatively correlated with the number of mm Hg the systolic blood pressure fell after the stressor had ceased (Table 20). Hence, the higher the current state of anxiety, the higher the pressure remained after the stressor ceased, and the higher general state of anxiety, the less the blood pressure dropped when the stressor ceased.

Since anxiety and perceived stress may play a vital role in one's cardiovascular response to stress, there may be a way to condition the effect so that the response is less dramatic when the stressor occurs again. Like interval training has the ability to condition the heart, psychological conditioning may serve as a protective factor to the stress response. According to Murray (2004), psychological conditioning is the process of training one "how to think," even in the midst of adverse stimuli. This intentional thought process has been found to have an outward effect on the body.

In a study comparing Army Infantry soldiers with psychologically conditioned Special Forces soldiers, it was found that Special Forces soldiers were able to recover, physically and psychologically, faster than Infantry soldiers after being exposed to an extreme stressor (Morgan, Wang, Rasmusson, Hazlett, Anderson, & Charney, 2001). Although both groups were identical at baseline, after 24 hours of survival training, the neuropeptide Y (an amino acid which helps regulate BP, appetite, and memory, and helps control anxiety) levels remained significantly below normal in the Infantry soldiers but returned to normal levels in the Special Forces soldiers (Morgan et al, 2001). Rather than producing an Allostatic Load, the intermittent high stress psychological exposure that the Special Forces soldiers were accustomed to in their training served as a psychological protective mechanism, containing biochemical results that affected BP (Morgan et al, 2001).

Research Question 2

Special Attention to Females

Over the years, more attention has been given to cardiovascular research in the female population. However, in the military, this population is under researched. In this study, females had a statically significant higher mean pulse rate before, during, and after the stressor when compared to males. At closer glance, this may have been attributed to their higher state anxiety score (46.17 vs. 35.90), higher trait anxiety scores (36.91 vs. 32.78), and higher perceived stress scores before (3.33 vs. 2.42), during (6.33 vs. 5.38), and after (1.92 vs. 1.77) the stressor.

Of all of these psychological measures, the most statistically significant findings was female higher state anxiety score (46.17 vs. 35.90, $p = .004$) regardless of the intensity or duration of the stressor. It is unclear if the females were nervous about the paintball exposure, which is similar to the competitive video games that are often marketed to and played by more males (Anderson & Dill, 2000). Another possibility could be the social conditioning differences in how anxiety and perceived stress are interpreted and expressed in the military environment. Females within the military may have to contend with more work-related issues than their civilian counterparts: Not only do female soldiers have to contend with things most civilian women battle, such as sexual harassment, job satisfaction, job performance, and pregnancies, but they also have the challenge of strength being mismatched to equipment use and job tasks, poorly designed equipment that does not conform to female anthropometrics and physiology, and gynecologic self-care issues in austere conditions (United States Army Medical Research and Material Command, 2010).

Although gender differences were not the focus of this study, there are other possible biological factors that could have played a role in the females having higher pulse rates. For example, studies have shown that there is a significantly greater sympathetic activity during the luteal phase of the menstrual cycle (Sato, Miyake, Akatu, & Kumashiro, 1995). It was found that estrogen, which is higher in the follicular phase (day 1-14 of the menstrual cycle), increased the release of the vasodilating substance nitric oxide, in turn causing a decrease in blood pressure (Sudhir , Jennings, Funder, & Komesaroff, 1996). However, progesterone, which is higher in the luteal phase (day 14-28 of the menstrual cycle), may be inhibiting the estrogen's influence on the autonomic nervous system, in turn causing higher blood pressure (Leicht, Hirning & Allen, 2003). Although the presence of testosterone has been associated with higher blood pressure, as seen in adolescent/puberty studies and polycystic ovary syndrome studies, there was no significant difference in blood pressure between the males and females in this study (Reckelhoff, 2001).

The Influence of Age

Although the participants in the study were fairly young (18-33 yrs), increased age positively correlated with elevated blood pressure during the stressor, as well as in the morning blood pressure surge poststressor. Since the during stressor measures and morning surge measures are sympathetic driven, whereas evening decline and recovery measures are more parasympathetic driven, this finding supports the theory of that increased age plays a role in impaired vascular endothelial function, increased intima-media wall thickness, and peripheral vasoconstriction, which in turn increases blood pressure even at rest (Seals, DeSouza, Donato, & Tanaka, 2008). Aging has also been associated with decreased resting parasympathetic control (Uchino, Holt-Lunstad, Bloor, & Campo, 2005). Although the influence of age on the cardiovascular system is not an immediate threat with this young group, continued stress exposure (whether psychological or physical) may accelerate the aging effect.

Genetics and Environment

Regardless of the type of stress one is exposed to, it is the genetic and environmental factors that determine the low or high responsivity to stress (Steptoe, 2000). Only 20 to 30 percent of the individual variation in systolic blood pressure is attributed to genes (Danziger, 2001). Although hypertension due to single gene abnormalities is rare, there are several genes that have been identified. These include) 6A allele of the angiotensin gene, 825T allele of the GNB3 gene, 47A and 79C alleles of the B2-adrenergic receptor gene, 946G allele of the epithelial sodium channel subunit gene, and CYP345 allele of the CPY3A isozyme 5 gene (Weder, 2007). In regard to the mechanisms in the stress response, genetic variations have been found in the adrenergic receptors of the sympathetic nervous system. The b2-adrenergic receptor was associated with Caucasians and African-Americans, whereas the a2-adrenergic receptor was associated with Caucasians only (O'Byrne & Caulfield, 1998). Although 43% of the participants reported a family history (mother and/or father) of hypertension, only one significant relationship (systolic blood pressure decline poststressor) was found between a family history of hypertension and the various cardiovascular measures.

In regard to ethnicity, Hispanics had higher pulse rates during the stressor, recovery period, and several hours after the stressor ceased. This was difficult to associate with race for many of the Hispanics in the sample found it difficult to choose between Caucasian and African-American when asked to identify their race. In regard to race, there was an inverse relationship between Caucasians and African-Americans in regard to the sleeping systolic and diastolic blood pressures. Those of African-American descent positively correlated with higher mean sleeping systolic (.360, *p* = <.05) and diastolic (.408, *p* <.05) blood pressures at baseline, which is consistent with the literature. Although African-Americans represented only 17% of the sample, this subset had the most adverse cardiovascular response to the stress response (elevated sleeping blood pressure and low blood pressure recovery), as well as being the highest at-risk group for hypertension according most research. Studies have found a sodium conservation allele and ancestral variants among African-Americans living near the equator; however, regardless of the latitude, this sensitivity was more prominent in modern culture societies (Weder, 2007). This may pose difficulty for African-American soldiers who ingest the high salt, ready-made meals that are often eaten during deployment. Although the genetic influence on cardiovascular response has been substantiated, other factors such as environmental and social aspects must also be taken into consideration.

Waist Circumference versus Body Mass Index

It is recommended that BMI and waist circumference be assessed in conjunction with one another when determining cardiovascular risk. Body mass, which only addresses height and weight, is divided into six sub categories (e.g., underweight, normal-weight, overweight, and obese class I, II, and III) (CDC, 2009; NHLBI, 2010). Waist circumference, on the other hand, is the measurement midway between the last rib and the iliac crest, and is classified into two categories (e.g., normal or high), which gives a better description of the presence of body fat (Janssen, Katzmarzy & Ross, 2002). If a BMI is equal to or greater than 25 kg/m^2, waist circumference should be less than 40 inches in males and less than 35 inches in females (NHLBI, 2010). Waist circumference did not appear to be an issue in the study, for only 4% of men had a waist circumference greater than 40 inches and only 8% of the females had a waist circumference greater than 35 inches.

In this study, BMI and waist circumference positively correlated with elevated blood pressure during the stressor. However, when pre and poststressor measures were assessed, BMI positively correlated with the morning blood pressure surge after the stressor, whereas waist circumference positively correlated with the morning blood pressure surge before the stressor. No explanation can be given for this difference. The BMI measurement has been the gold standard for quite some time; however, it may not be the best indicator in a young athletic military population. Many soldiers weight train to carry the heavy loads often associated with combat. This increased muscle mass may place the soldier in a higher BMI category, which makes waist circumference a better indicator. A study showed that health risk was greater in normal-weight, overweight, and class I obese women with high waist circumference when compared to normal-weight, overweight, and class I obese women with normal waist circumferences (Janssen et al, 2002). Furthermore, it has been found that abdominal (android) obesity poses a greater cardiovascular risk than lower-body (gynoid) obesity, once again showing that waist circumference may be a better indicator (Janssesn, 2002). The presence of increased fat in general also has a direct relationship with blood pressure. Leptin, which is secreted by the white adipocytes, acts on the hypothalamus, which decreases appetite and increases sympathetic nerve activity and energy expenditure (Feldstein &Julius, 2009). Leptin also adversely shifts the renal pressure natriuresis curve, leading to the relative sodium retention and in turn increasing blood pressure (Feldstein et al, 2009).

Cardiorespiratory Fitness

Cardiorespiratory fitness is based on three premises: frequency (how often), intensity (how hard), and time (how long) (American College of Sports Medicine & American Heart Association, 2007). The overall goal is to participate in a moderate-intensity aerobic physical activity that will elevate and sustain the heart rate between 50% and 85% of the maximum heart rate (AHA, 2010). Maximum heart rate is calculated by subtracting the age from 220. According to the AHA and the American College of Sports Medicine (2007), adults between the ages of 18 and 65 should participate in moderate-intensity aerobic physical activity for a minimum of 30 minutes five days a week, or vigorous-intensity aerobic activity for a minimum of 20 minutes three days a week.

In this study, higher APFT total and APFT run scores were negatively associated with the waking and sleeping pulse rates both pre and poststressor. Over the years, studies have continually shown that aerobic exercise plays a major role in the heart's ability to pump blood more efficiently throughout the body, in turn lowering the myocardial workload (McArdle, Katch, & Katch, 1996). This high level of fitness also impacts one's body fat composition, as evidenced by the relationship between high APFT run scores and low waist circumference. Although the APFT run scores were in the 78% range, this showed that even a moderate fitness level was enough to have a healthy effect on pulse rate and waist circumference. In the military setting, weight training is encouraged because it builds stronger bones and muscles. Weight training helps soldiers meet the physical challenges that come with bearing heavy equipment during combat; however, aerobic training is more essential to maintain cardiovascular health. In a study of young sedentary nonsmoking normotensive adults, six weeks of aerobic exercise lowered cardiovascular activity levels during rest, lowered psychological stress, and lowered recovery from stress more than weight training or no training at all (McArdle, Katch, & Katch, 1996).

Limitations

The study had several limitations. First, there was an inconsistency in the ability to obtain blood pressure measures during the stressor. In order to obtain accurate measures, minimal movement and proper arm placement of the mechanism are key. Although some valid readings were obtained during the stressor, there was no guarantee that participants remained still with their arms in the proper position. Heart rate variability would have been a better measure to assess during the stressor, whereas blood pressure during a stressor is not as important as the blood pressure obtained before and after the stressor. Heart rate variability could have been obtained by the use of commercial sporting equipment capable of capturing and storing heart rate data while participants were actively engaged in the activity. Second, mean calculations had to be used since all participants did not have equal numbers of measures. Depending on the number of measures each participant had for a given interval, mean calculations may or may not have produced a true picture. For example, if participant A1 had three measures and participant B20 had eight measures, would these means truly represent that particular group of measures? Third, due to an interruption in the combat training exercise, the exploratory study of a 60-person sample turned into a quasi-experiment comparing two 30- person samples. This in turn lowered the statistical power, which was validated using a retrospective power analysis (Table 27). Although this study produced many significant correlations that have been supported by the current literature, many of the correlations were weak, and stronger relationships may be noted with a larger sample size. Fourth, there was a low representation of the highest risk group

(African-American) for hypertension as well as a small representation of females. Finally, although the STAI is a tested instrument, and the Paintball Perceived Stress Questionnaire was validated by the STAI, there was no opportunity in the small data collection window to administer both questionnaires twice in order to assess their internal validity.

Implications for Education

The goal of this study was to assess the cardiovascular response of soldiers under a simulated combat stressor. Since this type of stressor over time may increase a soldier's risk for hypertension, prevention is one of the key educational concerns. The numerous Web sites and presence of blood pressure machines in local supermarkets and drug stores make cardiovascular knowledge, assessment, and control available to all. However, with all of these available resources, hypertension still remains a problem. The fact that this disease has no symptoms and people can still function in their daily lives makes identification less of a priority. To educate participants on their cardiovascular health, each were given two comprehensive cardiovascular reports, which contained user-friendly graphs and statistics regarding the condition of their cardiovascular system (Appendices R and S). Prestressor and poststressor graphs were superimposed so that participants were able to see the circadian rhythm of their blood pressure, as well as what stress was capable of doing, in turn warranting the need for stress awareness and stress reduction methods. Having this personalized information was believed to have made more of an impact on the participants than stating statistics about the general population. Participants were also provided a blood pressure fact sheet and tracking cards for their wallets as a subtle reminder of the personal responsibility for their cardiovascular health (Appendix T).

As for academia, the basics of proper blood pressure measurement, awareness of the neuro-endocrine-urinary influence on blood pressure, and attention to diurnal changes are key to a nursing student's proper assessment of the cardiovascular system. Nursing students who have clinical rotations in military-affiliated medical treatment facilities should understand the residual effects of deployment stress and that many soldiers who have deployed in the past may show exaggerated cardiovascular response and signs of stress even though no stressor is present.

Implications for Practice

This study provided information on the efficacy of using ABPMs when assessing cardiovascular health. Most blood pressures are taken via a single assessment in an array of different conditions and may vary from reading to reading. Currently, soldiers with normal blood pressures are rechecked every two years (DH&HS, 2004), those with pre hypertension are rechecked every year, those with stage 1 hypertension are rechecked within two months, and those with stage 2 hypertension are rechecked in one month (DH&HS, 2004). An ABPM assessment may be able to provide continuous measures for a more thorough analysis in a more cost-effective way. In a study assessing the efficacy of clinical measures versus ambulatory measures for proper control of hypertension, it was found that proper control was achieved in 8.3% of the clinical blood pressures (95% CI 4.8–11.8) and in 55.6% of the ABPM measures (95% CI 49.3–61.9) (Rodriguez-Roca, Alonso-Moreno, Garcia-Jimenez, Hidalgo-Vega, Llisterri-Caro, Barrios-Alonso, et al., 2006). Measures such as morning surge, evening decline, and percentage of time the blood pressure remained in a particular range provide the necessary information to not only identify risk, but to also distinguish the type of hypertension for proper treatment. Just as annual mammograms and Pap smears are recommended, an annual ambulatory

BP assessment should be considered in high-risk populations whether individuals are symptomatic or not. This may provide quantitative measures of pertinent information to establish a cardiovascular trend that can be followed in future assessments. The study also showed that it was four times more expensive to use clinical blood pressures (€ 940 vs. € 238) to manage patients with hypertension than it was to use ABPMs**.**

A second implication for practice is the use of alternative and natural methods to control blood pressure. As stated in the introduction, it is estimated that $76.6 billion will be spent on direct and indirect costs relating to hypertension in 2010. These costs are often attributed to hospital visits and pharmaceuticals. However, these costs may be reduced by using less expensive and more natural methods such as dietary supplements like vitamins C and E, potassium, magnesium, Omega 3 fatty acids, Coenzyme Q10, L-Arginine, and Taurine; all in which have been shown to have a positive effect on the cardiovascular system (Khosh, 2001). Botanicals such as Arjuno Bark, Forskolin, Harwthorne, Olive Leaf, European Mistletoe, Yarrow, Black Cumin Seed, Indian Snakeroot, and garlic have not only been shown to decrease blood pressure, but also to decrease cholesterol levels (Khosh, 2001). There are even alternative medical devices to lower blood pressure on the market, such as the *RESPeRATE,* which use the principles of controlled breathing (found in yoga and meditation) to help lower blood pressure and heart rate (Elliot, 2006). Physical activities such as yoga, Tai chi, Qi gong, progressive muscle relaxation, and meditation, which are rarely seen as structured group practices in the military setting, have all been shown to be instrumental in decreasing anxiety, depression, heart rate, and blood pressure (Lee, Kim, & Moon, 2003; Tsai, Wang, Chan, Lin, Wang, Tomlinson, et al., 2003; and Barnes, Davis, Murzynowski, & Treiber, 2004). Six weeks of acupuncture treatment was found to significantly lower mean ambulatory blood pressures in a sample of 160 older adults, wherein the effects actually ceased when the intervention was discontinued (Flachskampf, Gallasch, Gefeller, Gan, Mao, Pfahlberg, et al., 2007). Even the use of sound technology such as *Hemi-Sync* or *Brain Sync*, where two tones of different frequencies are sent to the left and right ears to influence EEG activity, have been shown to influence mood, enhance psychomotor performance, and promote relaxation (which decreases heart rate and blood pressure), all important aspects of deployment health (Lane, Kasian, Owens, & March, 1998; Brain Sync, 2010). These mind-body techniques and bio-field mechanisms would place health promotion and prevention back into the hands of the patient, which has always been a key goal of nursing.

The third and probably most important implication for practice in the military setting is for clinicians to understand the medications used in treatment of post-traumatic stress disorder (PTSD), which may mask hypertension. Although no participants in this study were diagnosed with PTSD, the study showed that high anxiety could still possibly produce a residual stress response well after a stressor ceased. However, this residual effect may be masked in soldiers being pharmacologically treated for PTSD. Although most soldiers who are diagnosed with PTSD are treated with counseling and psychotherapy, there are a few with symptoms severe enough to warrant medication. Some of these medications fall into the anti-hypertensive group (e.g., alpha adrenergic agonist and beta-blockers). Prazosin is an alpha adrengergic blocker that has been used consistently in treating nightmare and sleep disturbances in PTSD patients (Raskind, Peskind, Hoff, Hart, Holmes, Warren, et al., 2007). Propanolol, a beta blocker, is often used to prevent PTSD-related psychophysiological arousal, which often comes when recalling traumatic memories (National Center for PTSD, 2008). While medication used for PTSD may reduce blood pressure, the question remains about what happens with the cardiovascular system when the soldiers are taken off this medication. Abrupt cessation of these drugs is contraindicated; however, few if any studies have been conducted on this effect when given to someone who was not hypertensive to begin with.

Implications for Research

In viewing the current state of military operations abroad, it can be assumed that military deployments will continue. The physical and psychological stress of multiple deployments may eventually affect soldiers who remain in the service. By assessing soldiers of varied deployment histories, researchers may be able to assess if longer or shorter deployments, or low or high frequency of deployment, have an effect on blood pressure.

A second implication for research is the use of paintball as a proxy for simulated combat when conducting stress and physiologic studies in the combat setting. The use of paintball was found to be a very appropriate stressor for the purpose of this study. Most stress studies often use running on a treadmill, exposure to cold pressors, complicated manual dexterity activities, and psychological stressors to assess the stress response. However, these are in no way similar to the level of intensity that is encountered in combat. Paintball allowed for the participants to utilize the same equipment that they would use in combat, achieve anaerobic states through sporadic movement, actively participate in their environmental element, and engage in the psychological stress of decision-making under pressure. Paintball also allowed for the true experience and seriousness of being struck by a projectile, which is not often experienced when using the traditional LASER tag combat training methods. More importantly, while research data are being collected, pertinent training exercises can be conducted simultaneously, in turn saving money, time, and resources.

A third implication for research is the advancement of the cardiovascular components of the Warfighter Physiologic Monitoring System (WPMS), which is currently being studied at the U.S. Army Natick Soldier Systems Center in Massachusetts. This system is designed to collect physiologic measures in combat such as motion detection, heart rate, respiratory rate, and water intake (Hoyt, Reifman, Coster & Buller, 2002). All of these components are necessary for a medic or commander to provide the appropriate assessment for needed interventions and to assess likelihood of survival on the battlefield; however, heart rate may not provide the necessary cardiovascular information to make a proper cardiovascular assessment. For example, if the sensor notes that an infantry soldier has a heart rate heart rate of 175 beats per minute, this could mean a variety of things: he is hemorrhaging or having a sympathetic nervous response, or his sensor is picking up extra beats on movement. A better cardiovascular indicator is needed for the WPMS. More research needs to be conducted on ways of obtaining more comprehensive cardiovascular measures while in active motion.

The fourth and final implication for research is the need to conduct more biobehavioral research in the cardiovascular realm. Instead of conducting research to find better and often more expensive ways to treat hypertension, efforts should be made to better explain and predict the relationships between individual differences, psychological differences, and health behaviors so that individualized prevention models can be developed. Also, research should be conducted using non-pharmacological approaches such as herbal supplements, yoga, Tai chi, Qi gong, acupuncture, and/or *Hemi-Sync/Brain Sync* technology with cortisol, epinephrine, and/or neuropeptide Y as physiologic measures.

Implications for Military Health Policy

This study showed that even young soldiers with no deployment history had residual cardiovascular effects after being exposed to a simulated combat stressor. The question now is to what extent is this residual effect has on soldiers with multiple deployments. Currently the deployment health assessment is comprised of a questionnaire and screening interview. Cardiovascular measures may or may not be taken in the process. Soldiers are required to complete the Pre Deployment Health Assessment Form (DD 2795) at least 30 days prior to deployment (Deployment Health Clinical Center [DHCC], 2003). Upon their return, this process is repeated using the Post Deployment Health Assessment Form (DD 2796) (DHCC, 2003). The two forms then compared to see if there are any health changes or if there is a need for health referral (DHCC, 2003). Once again, cardiovascular measures may or may not be taken. A third assessment is completed 90 to 180 days after returning from deployment only if soldier has deployed more than 30 days, to locations outside the continental U.S., or to locations without permanent military treatment facilities (Government Accounting Office, 2009). This reassessment is to determine the soldier's mental and not physiologic status. There are many opportunities within this cycle of assessment to conduct a cardiovascular evaluation. Currently the only scheduled cardiovascular assessment for soldiers under age 40 is the single blood pressure measure that is taken during the Period Health Assessment, which is conducted every 12 months (United States Department of Defense, 2006). The problem is that if a soldier is deployed and misses his/her assessment window, it is not known when the next appointment will be scheduled. A policy recommendation is to incorporate cardiovascular assessments during all deployment health screenings. Since most cardiovascular changes secondary to stress will be seen after the stress exposure, postdeployment cardiovascular measures are essential. However, without pre deployment measures to compare to, a proper assessment cannot be made.

Summary

This study evaluated the cardiovascular response of young soldiers under a simulated combat stressor in order to assess which characteristics played the most significant role. A three- to four-hour simulated combat training exercise was enough to elicit a residual stress response that could be seen well into the following morning. This study also showed that systolic blood pressure is the most dynamic and informative of the cardiovascular measures when assessing the stress response. Individual differences such as female gender, older age, African-American race, Hispanic ethnicity, higher BMI, higher waist circumference, and past deployment history had weak but significant relationships with various cardiovascular measures before, during, and after the stressor. State and trait anxiety levels, as well as perceived stress, correlated with poststressor measures only, with females scoring higher than males in all cases. Furthermore, level of fitness played a role in resting pulse rate, but had no direct relationship to blood pressure. The psychological stress of performing combat tasks alone, although not physically challenging, was enough to elicit a stress response comparable to an intense physical stressor. If a three- to four-hour exposure to a stressor was enough to produce a residual effect, one can only imagine what six to 12 months of deployment in an austere environment may produce. Pre, post, and six-month postdeployment health assessments may not only help identify those at higher risk, but will provide opportunities to instill methods to prevent this silent yet deadly disease.

APPENDIX A: IRB APPROVAL

University of Central Florida

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Human Research

From: **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To: **MeLisa A. Gantt**

Date: **February 10, 2010**

Dear Researcher:

On 2/10/2010, the IRB approved the following modifications/human participant research until 2/9/2011 inclusive:

Type of Review:	UCF Initial Review Submission Form
Project Title:	The Effect of Combat Exercises on Cardiovascular Response: An Exploratory Study
Investigator:	MeLisa A. Gantt
IRB Number:	SBE-10-06686
Funding Agency:	TriService Nursing Research Program(TSNRP)
Grant Title:	Title of Grant: TriService Nursing Research Program FY 2010 Call for Proposals (Cycle A) Title of Study: The Effect of Combat Exercises on Cardiovascular Response: An Exploratory Study (Application Ref #N10-008)
Research ID:	N/A

The Continuing Review Application must be submitted 30days prior to the expiration date for studies that were previously expedited, and 60 days prior to the expiration date for research that was previously reviewed at a convened meeting. Do not make changes to the study (i.e., protocol, methodology, consent form, personnel, site, etc.) before obtaining IRB approval. A Modification Form **cannot** be used to extend the approval period of a study. All forms may be completed and submitted online at https://iris.research.ucf.edu .

If continuing review approval is not granted before the expiration date of 2/9/2011, approval of this research expires on that date. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

Use of the approved, stamped consent document(s) is required. The new form supersedes all previous versions, which are now invalid for further use. Only approved investigators (or other approved key study personnel) may solicit consent for research participation. Participants or their representatives must receive a copy of the consent form(s).

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Joseph Bielitzki, DVM, UCF IRB Chair, this letter is signed by:

Signature applied by Joanne Muratori on 02/10/2010 04:25:22 PM EST

IRB Coordinator

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APPENDIX B: RECRUITMENT FLYER

Do You Have the Heart for Paintball?

The University of Central Florida's College of Nursing, in conjunction with the Army ROTC Department, is conducting a study looking at blood pressure changes during simulated combat.

If you:

1) Are 18 years of age or older
2) Have **<u>NO</u>** cardiovascular health issues
3) Are **<u>NOT</u>** taking any medication to treat high blood pressure
4) Have the mental and physical stamina play a six session of game paintball and wear a small blood pressure monitor for 48 continuous hours

Please contact **MeLisa Gantt**
University of Central Florida
College of Nursing
4000 Central Florida Blvd
Orlando, FL 32816
melisa_gantt@knights.ucf.edu
407-516-1009

UCF University of Central Florida IRB
IRB NUMBER: SBE-10-06686
IRB APPROVAL DATE: 2/10/2010
IRB EXPIRATION DATE: 2/9/2011

APPENDIX C: CONSENT 1

University of Central Florida

The Effect of Combat Exercise on Cardiovascular Response: An Exploratory Study

Informed Consent

Principal Investigator:	MeLisa Gantt, RN MSN CNOR RNFA.
Faculty Supervisor:	Mary Lou Sole, RN, PhD, CCNS, FAAN, FCCM
Sponsor:	TriService Nursing Research Program
Investigational Site(s):	University of Central Florida, Army ROTC Department Orlando Paintball

Introduction: Researchers at the University of Central Florida (UCF) study many topics. To do this we need the help of people who agree to take part in a research study. You are being invited to take part in a research study which will include approximately 60 UFC Army Reserve Officer Training Corps (ROTC) Cadets. You have been asked to take part in this research study because you:

1) Are18 years of age or older
2) Have no known cardiovascular health issues
3) Are not taking any medication to treat high blood pressure
4) Have no mental or physical limitation that will prohibit you from playing a six scenario game of paintball
5) Have no physical or environmental limitations that will prohibit you from wearing a small blood pressure monitor for 48 continuous hours

MeLisa Gantt, the person doing this research, is a doctoral student at the College of Nursing. Because the researcher is a doctoral student she is being guided by Dr Mary Lou Sole, a UCF faculty supervisor at the College of Nursing.

What you should know about a research study:

- Someone will explain this research study to you.
- A research study is something you volunteer for.
- Whether or not you take part is up to you.
- You should take part in this study only because you want to.
- You can choose not to take part in the research study.
- You can agree to take part now and later change your mind.
- Whatever you decide it will not be held against you.
- Feel free to ask all the questions you want before you decide.

Purpose of the research study: The purpose of this study is to assess the blood pressure and pulse rate changes that occur when one is exposed to combat related stressors. By measuring a series of blood pressures before, during and after exposure to these stressors, researchers can provide information that will help identify those who are at higher risk for high blood pressure as well as to help health care providers, military leaders, and policy makers understand the importance of obtaining blood pressure assessments before and after military deployments.

What you will be asked to do in the study: First, you will be scheduled for a private interview to answer a few demographic questions such as your age, gender, ethnicity, and family history of high blood pressure. Your height, weight and recent Army Physical Fitness Test (APFT) score will be obtained from your APFT card that is on file with the ROTC Department. Your waist circumference will also be taken with cloth tape measurer.

Two days before the paintball exercise, you will be fitted with an ambulatory blood pressure monitor on your non-dominate arm and will be given verbal and documented instructions on the wear and care of the monitor. Instructions include how to apply, temporarily pause, and remove the device for emergencies or activities such as bathing; as well as the crucial times that the monitor must be worn. You will NOT have to wear the monitor on that day.

The following morning you will apply the monitor within two hours of rising and keep the monitor on for the next 48 hours. The monitor will obtain your blood pressure every 30 minutes during your awake hours and every 60 minutes when you are asleep. You may engage in any activities that you would normally do, with the exception any strenuous exercise (e.g. weight lifting, running, etc.).

The next morning (the day of the paintball exercise) it is important that you DO NOT remove the monitor for the first two hours or rising. Per the ROTC Operation Order, you will meet at the ROTC battalion area and transported to the paintball site via a ROTC van. At the paintball site you will be fitted with a protective mask, issued a paintball maker (simulated rifle), a bag of 500 paint-filled gelatin-coated balls (ammunition), and given a safety briefing. You will then be asked to pick a folded piece of paper out of a hat. Each paper will list the team in which you will be assigned as well as which paintball scenario you will serve as leader. Once divided into two teams of five, the monitors will be set to obtain you blood pressure every 10 minute for the duration of the exercise. The paintball scenarios will be lead by your ROTC instructors and monitored by the paintball staff.

At the end of the paintball exercise, you will be given a short 4-question survey assessing your perceived level of stress during the different phases of the exercise. You will be served lunch and after an hour your monitor will be set back to initial protocol (every 30 minutes while awake and every 60 minutes while asleep). You will then be transported back to the ROTC battalion area. You are to continue to wear the monitor until two hour after rising the next day.

Arrangements will be made to collect the monitors within two days at the ROTC battalion area. Once the study is complete, you will be given a report of your cardiovascular health along with some information from the American Heart Association about maintaining a healthy blood pressure.

Location: The interviews will take place in a private room at the ROTC battalion area. The paintball exercise will take place Orlando Paintball located at 7215 Rose Avenue, Orlando, Florida 32810.

Time required: We expect that you will be in this research study for 48 hours.

Photography: You may be photographed during the paintball exercise. If you do not want to be photographed you will still be able to be in the study. Discuss this with the researcher or a research team member. Photographs will be kept in a locked, safe place. Photographs may be kept indefinitely, based upon ROTC or Department of Defense protocol.

Funding for this study: This research study is being paid for by the TriService Nursing Research Program.

Risks: There are minimal risks in participating in this study. These risks are no greater than the risk you encounter on a typical ROTC squad tactic and field exercise. Paintball is considered to be a safe team sport with proper safety equipment and supervision. There is a small risk of bruising if struck with the paint-filled ball if struck at close range in an unprotected area. To minimize this risk, you will be required to wear a tactical protection mask (which will be provided), closed-toe shoes, and comfortable long sleeve shirt and pants. In the event you need minor medical attention, a Registered Nurse will be on site. Any medical issue will be handled in the same manner as it would at any other ROTC training exercise.

As for the blood pressure monitor, although the device is latex free, there is a chance of skin irritation when the device is worn for a long period of time. To minimize this risk, you may remove your monitor with the exception of the crucial times listed on the instruction card. To decrease sweating and irritation due to the blood pressure cuff, a thin layer of Webril (cotton roll) will be available to apply under the cuff. To avoid irritation from the slippage of the cuff upon movement, the cuff is equipped with a mechanism that clips to an adhesive patch that will be applied to the skin. Minimal or no pain is to be expected after the first blood pressure reading for the monitor bases its maximum pressure on its previous measurement.

In the event that your cardiovascular report warrants medical attention, you will be given a copy of the report and advised to make an appointment with your primary care provider as soon as possible. Your information will NOT be shared with your ROTC instructions.

Benefits: We cannot promise any benefits to you or others from your taking part in this research. However, possible benefits include increased knowledge about assessing and maintaining a proper blood pressure and an opportunity to use paintball as an alternate training experience in preparation for future field exercises.

Compensation: By participating in this study lunch will be provided at the end of the paintball exercise. Also, you will be given a free comprehensive report on your cardiovascular health along with the American Heart Association Blood Pressure Tracker instructions and wallet card.

Confidentiality: We will limit your personal data collected in this study to people who have a need to review this information. We cannot promise complete secrecy. The investigator will make every effort to prevent anyone who is not on the research team from knowing any of your personal information and results, to include your chain of command. You will be assigned an alpha-numeric code as your identifier. The list connecting your name to this number will be kept in a locked file cabinet in the investigator's office as well as saved on a password protected computer. Your information will be compiled with information from the other persons who took part in this study for analyses and when the study is presented or published your name will not be used.

The Institutional Review Board of the University of Central Florida, Orlando, Florida; the Uniformed Services University of the Health Sciences, Bethesda, Maryland; and other federal agencies that provide oversight for human subjects protection may request to see your records for legal or auditing reasons.

Study contact for questions about the study or to report a problem: If you have questions, concerns, or complaints, or think the research has harmed you, contact MeLisa Gantt (melisa_gantt@knights.ucf.edu), Doctoral Student, PhD in Nursing Program, College of Nursing (407) 516-1009 or Dr Mary Lou Sole (msole@mail.ucf.edu), Faculty Supervisor, College of Nursing (407) 823-5133.

IRB contact about your rights in the study or to report a complaint: Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been reviewed and approved by the IRB. For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901. You may also talk to them for any of the following:

- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.
- You want to talk to someone besides the research team.
- You want to get information or provide input about this research.

Withdrawing from the study:
If you decide to leave the study, contact the investigator so that the investigator can retrieve the blood pressure monitor. The person in charge of the research study or the sponsor can remove you from the research study without your approval. Possible reasons for removal include failure to follow instructions of the research staff or if the person in charge decides that the research study is no longer in your best interest. The sponsor can also end the research study early. We will tell you about any new information that may affect your health, welfare or choice to stay in the research.

APPENDIX D: CONSENT 2

The Effect of Combat Exercise on Cardiovascular Response:

An Exploratory Study

Informed Consent

Principal Investigator:	MeLisa Gantt, RN MSN CNOR RNFA.
Faculty Supervisor:	Mary Lou Sole, RN, PhD, CCNS, FAAN, FCCM
Investigational Site(s):	University of Central Florida, Army ROTC Department Orlando Paintball

Introduction: Researchers at the University of Central Florida (UCF) study many topics. To do this we need the help of people who agree to take part in a research study. You are being invited to take part in a research study which will include approximately 60 UCF Army and/or Air Force Reserve Officer Training Corps (ROTC) Cadets. You have been asked to take part in this research study because you:

1) Are18 years of age or older
2) Have no known cardiovascular health issues
3) Are not taking any medication to treat high blood pressure
4) Have no mental or physical limitation that will prohibit you from playing paintball for approximately 4 hours.
5) Have no physical or environmental limitations that will prohibit you from wearing a small blood pressure monitor for 48 continuous hours
6) Have not been deployed for more than 30 days

MeLisa Gantt: The person doing this research is a doctoral student at the College of Nursing. Because the researcher is a doctoral student she is being guided by Dr Mary Lou Sole, a UCF faculty supervisor at the College of Nursing

What you should know about a research study:

- Someone will explain this research study to you.

- A research study is something you volunteer for.
- Whether or not you take part is up to you.
- You should take part in this study only because you want to.
- You can choose not to take part in the research study.
- You can agree to take part now and later change your mind.
- Whatever you decide it will not be held against you.
- Feel free to ask all the questions you want before you decide.

Purpose of the research study: The purpose of this study is to assess the blood pressure and pulse rate changes that occur when one is exposed to combat related stressors. By measuring a series of blood pressures before, during and after exposure to these stressors, researchers can provide information that will help identify those who are at higher risk for high blood pressure as well as to help health care providers, military leaders, and policy makers understand the importance of obtaining blood pressure assessments before and after military deployments.

What you will be asked to do in the study: First, you fill out a short questionnaire to answer a few demographic questions such as your age, gender, ethnicity, and family history of high blood pressure. Second, you will be given a 20-item questionnaire asking about your general state of anxiety. Your height, weight and recent fitness score will be obtained from your ROTC records and your waist circumference will be taken with cloth tape measurer.

Two days before the paintball exercise, you will be fitted with an ambulatory blood pressure monitor on your non-dominate arm and will be given verbal and documented instructions on the wear and care of the monitor. Instructions include how to apply, temporarily pause, and remove the device for emergencies or activities such as bathing; as well as the crucial times that the monitor must be worn.

The following morning you will apply the monitor within two hours of rising and keep the monitor on for the next 48 hours. The monitor will obtain your blood pressure every 30 minutes during your awake hours and every 60 minutes when you are asleep. You may engage in any activities that you would normally do, with the exception any strenuous exercise (e.g. weight lifting, running, etc.).

The next morning (the day of the paintball exercise) it is important that you DO NOT remove the monitor for the first two hours of rising. Transportation to and from the paintball site will be coordinated with the ROTC Training Officer. At the paintball site you will be fitted with a protective mask, issued a paintball maker (simulated rifle), a bag of 500 paint-filled gelatin-coated balls (ammunition), and given a safety briefing. You may be asked to pick a folded piece of paper out of a hat. Each paper will list the team in which you will be assigned as well as which paintball scenario you may serve as leader. During the exercise, the monitors will automatically e set to obtain you blood pressure every 15 minute for the duration of the exercise. The paintball scenarios will be lead by your ROTC instructors and monitored by the paintball staff.

At the end of the paintball exercise, you will be given two questionnaires. One consisting of 20 questions and the other consisting of 4 questions assessing your anxiety and perceived level. You will then be transported back to the ROTC battalion area. You are to continue to wear the monitor until two hour after rising the next day.

Arrangements will be made to collect the monitors within two days at the ROTC department. Once the study is complete, you will be given a report of your cardiovascular health along with some information from the American Heart Association about maintaining a healthy blood pressure.

Location: The initial interview questionnaires will be completed in one of the ROTC classrooms. The paintball exercise will take place at Orlando Paintball located at 7215 Rose Avenue, Orlando, Florida 32810 or Xtreme Paintball Xperience located at 1300 S. Poinciana Blvd, Kissimmee, Florida 34746.

Time required: We expect that you will be in this research study for 48 hours.

Photography: You may be photographed during the paintball exercise. If you do not want to be photographed you will still be able to be in the study. Discuss this with the researcher or a research team member. Photographs will be kept in a locked, safe place. Photographs may be kept indefinitely, based upon ROTC or Department of Defense protocol.

Risks: There are minimal risks in participating in this study. These risks are no greater than the risk you encounter on a typical ROTC training exercise. Paintball is considered to be a safe team sport with proper safety equipment and supervision. There is a small risk of bruising if struck with the paint filled ball if struck at close range in an unprotected area. To minimize this risk, you will be required to wear a tactical protection mask (which will be provided), closed-toe shoes, and comfortable long sleeve shirt and pants. In the event you need minor medical attention, a Registered Nurse will be on site. Any medical issue will be handled in the same manner as it would at any other ROTC training exercise.

As for the blood pressure monitor, although the device is latex free, there is a chance of skin irritation when the device is worn for a long period of time. To minimize this risk, you may remove your monitor with the exception of the crucial times listed on the instruction card. To decrease sweating and irritation due to the blood pressure cuff, a thin layer of Webril (cotton roll) can be applied applied under the cuff. To avoid irritation from the slippage of the cuff upon movement, the cuff is equipped with a mechanism that clips to an adhesive patch that will be applied to the skin. Minimal or no pain is to be expected after the first blood pressure reading for the monitor bases its maximum pressure on its previous measurement.

In the event that your cardiovascular report warrants medical attention you will be given a copy of the report and advised to make an appointment with your primary care provider as soon as possible. Your information will NOT be shared with your ROTC instructions.

Benefits: We cannot promise any benefits to you or others from your taking part in this research. However, possible benefits include increased knowledge about assessing and maintaining a proper blood pressure and an opportunity to use paintball as an alternate training experience in preparation for future field exercises.

Compensation: By participating in this study you will be given free admission to the paintball site during the day of the data collection. Also, you will be given a free comprehensive report on your cardiovascular health along with the American Heart Association Blood Pressure Tracker instructions and wallet card.

Confidentiality: We will limit your personal data collected in this study to people who have a need to review this information. We cannot promise complete secrecy. The investigator will make every effort to prevent anyone who is not on the research team from knowing any of your personal information and results, to include your chain of command. You will be assigned an alpha-numeric code as your identifier. The list connecting your name to this number will be kept in a locked file cabinet in the investigator's office as well as saved on a password protected computer. Your information will be compiled with information from the other persons who took part in this study for analyses and when the study is presented or published your name will not be used.

Study contact for questions about the study or to report a problem: If you have questions, concerns, or complaints, or think the research has harmed you, contact MeLisa Gantt (melisa_gantt@knights.ucf.edu), Doctoral Student, PhD in Nursing Program, College of Nursing (407) 516-1009 or Dr Mary Lou Sole (msole@mail.ucf.edu), Faculty Supervisor, College of Nursing (407) 823-5133.

IRB contact about your rights in the study or to report a complaint: Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been reviewed and approved by the IRB. For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901. You may also talk to them for any of the following:

- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.
- You want to talk to someone besides the research team.
- You want to get information or provide input about this research.

Withdrawing from the study:
If you decide to leave the study, contact the investigator so that the investigator can retrieve the blood pressure monitor. The person in charge of the research study can remove you from the research study without your approval. Possible reasons for removal include failure to follow instructions of the research staff or if the person in charge decides that the research study is no longer in your best interest. We will tell you about any new information that may affect your health, welfare or choice to stay in the research.

APPENDIX E: LETTER OF SUPPORT: UNIVERSITY OF CENTRAL FLORIDA ARMY ROTC DEPARTMENT

DEPARTMENT OF THE ARMY
US ARMY ROTC BATTALION
UNIVERSITY OF CENTRAL FLORIDA
SIXTH BRIGADE, UNITED STATES ARMY CADET COMMAND
P. O. BOX 163377
ORLANDO, FL 32816-3377

ATCC-FFL-UC

28 October 2009

MEMORANDUM FOR LTC MeLisa Gantt, University of Central Florida, College of Nursing (PhD Program), 4000 Central Florida Blvd, Orlando, Florida 32816

SUBJECT: Support of Research Study

1. The Army Reserve Officer Training Corps (ROTC) Department at the University of Central Florida (UCF) will support your research study entitled "The Effect of Combat Exercises on Cardiovascular Response". This collaboration will not only provide pertinent information about deployment health but will also serve as a team building and tactical training exercises for the Cadets. Participation in this study will be dependant on the approval of UCF's Internal Review Board.

2. Using paintball as the simulation combat exercise, approximately 60 third-year Cadets will participate in combat scenarios while wearing ambulatory blood pressure monitors. Based on the risk assessment, this study poses minimal risk.

3. After recruitment and final selection of Cadets has been made, the ROTC Department will work with you to construct a rotation matrix to accommodate all participants in the allotted timeline. Meeting times and transportation of Cadets will be discussed at a later date.

4. Major Steven Celeste (SCeleste@cecs.ucf.edu or steven.celeste@us.army.mil) will serve as the primary point of contact.

SEAN M. MORGAN
LTC, IN
Commanding

APPENDIX F: LETTER OF SUPPORT: TIBA MEDICAL

TIBA MEDICAL
www.tibamedical.com

March 4, 2009

To Whom It May Concern,

This letter is in support of a research proposal by Major MeLisa A. Gantt RN MSN CNOR RNFA, Army Doctoral Student at the College of Nursing at the University of Central Florida. Major Gantt is putting forward a research proposal to study hypertension in warfighters facing simulated and field combat situations.

We have discussed the requirements and specifics of the research protocol with Major Gantt and believe that our Ambulo 2400 Ambulatory Blood Pressure Monitoring (ABPM) systems can provide a valuable tool in obtaining blood pressure readings information required as part of the research. We look forward to supporting Major Gantt as she moves forward on this important study.

Please do not hesitate to contact us if we can provide further information and references regarding our systems and their use in clinical and research applications.

Sincerely yours,

Merat Bagha
President

2701 NW Vaughn St., Suite 470, Portland, Oregon 97210 U.S.A.
Toll Free Telephone/Fax: 1-800-985-TIBA

APPENDIX G: LETTER OF SUPPORT: XTREME PAINTBALL

Xtreme Paintball Xperience

March 22, 2010

LTC MeLisa Gantt
University of Central Florida
College of Nursing (PhD Program)
4000 Central Florida Blvd
Orlando FL 32816

Via email: mganttphd@gmail.com

Dear LTC Gantt:

I hope this message finds you well.

The purpose of this writing is to inform you that Xtreme Paintball Xperience would be honored to host the upcoming University of Central Florida's Army ROTC exercises and research study.

XPX is a Themepark for Paintball™ created by a group of professional production guys and players that offers an Xtreme Paintball Xperience for anyone with an appetite and desire for adventure. XPX has the largest fields in Central Florida and the best mix of paintball amenities. Our Total Immersion Action Adventure™ caters to both casual players and xtremely serious players with themed scenario games played on 30 acres of themed woods ball fields and themed urban ball fields.

Come alone or in a group, either way, XPX paintball is a great way to spend a day or an entire weekend. You can celebrate a birthday have a bachelor party or teambuilding event. Whatever the occasion and whenever it is, XPX paintball will make your event a fun-filled and exciting adventure.

For more information and video field tours, please visit us on the web at www.XPXFL.com.

Our entire team is enthusiastically looking forward to hosting your event.

With highest regards,

Bryan S. Sedwick
CXO/CVO

PO Box 470154
Celebration FL 34747-0154
Voice: 321.248.3838
www.XPXFL.com

APPENDIX H: TIBA MEDICAL AMBULO 2400 SPECIFICATIONS

PRODUCT SPECIFICATIONS	
Dimensions	119mm × 68mm × 32mm (4.7" × 2.7" × 1.2")
Weight	253 grams (9 oz.)
Measurement Principle	Patented oscillometric technique with linear deflation
Measurement Ranges	Systolic 60 to 280 mmHg Diastolic 30 to 160 mmHg Pulse Rate 30 to 180 bpm
Measurement Accuracy	Blood Pressure: ±3 mmHg mean difference, ±8 mmHg standard deviation Pulse Rate: ±3 bpm According to ANSI/AAMI SP10:2002 & British Hypertension Society; Grade: A/A
Measurement Intervals	Four adjustable intervals during 24-hour periods, each configurable to 0, 5, 10, 15, 20, 25, 30, 45, 60, 75, 90, 105, or 120-minute measurements. Optional randomization factor up to ± 75% within intervals
Available Cuffs	EasyWear + Reusable & Disposable Regular, Large and Small Adult
Actigraphy	Recording of 3-axis of motion via accelerometer for display and categorization of awake/asleep cycles via application software
Memory	Solid-state Flash technology Sufficient for 3000 blood pressure measurements and 7 days of continuous actigraphy
PC Interface	USB
Battery	2 x 1.2V NiMH Rechargeable Batteries Sufficient for approximately 300 measurements
Software	Hypertension Diagnostics Suite for Microsoft® Windows® XP SP2 and Vista®

PART NUMBER	DESCRIPTION
001-2400-01	Ambulo 2400 Complete System: ABPM device, software CD, hook-up kit (pouch, shoulder strap, extension hose), 3 reusable cuffs (small, regular and large adult), EasyWear cuff, User's Guide w/Quick Start, 2 NiMH AA batteries, patient diary sheets (25), 1-year manufacturer's warranty
900-0001-01	Extended Warranty: this option extends the manufacturer's warranty from 1 year to 2 years
900-0002-01	Damage Protection Plan: protects the system against any and all damage the system might incur, not including theft, for the first year
900-0003-01	Premium Service Package: extends manufacturer's warranty from 1 year to 2 years, and includes 2 full years of Damage Protection Plan

Tiba Medical, Inc.
2701 NW Vaughn St., Suite 470
Portland, OR 97210, U.S.A.

Toll-free U.S. & Canada
Phone/Fax: 1.800.985.8422
Direct Phone: 1.503.222.1500

Email: info@tibamedical.com

Web: www.tibamedical.com

Made in the USA

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Ambulo™ 2400

24-Hour Ambulatory Blood Pressure Monitoring System

INNOVATION, ACCURACY & RELIABILITY

Diagnose and Manage your Hypertensive Patients

Having trouble managing your hypertensive patients? No problem. The Ambulo 2400 is a complete solution, giving you the tools to diagnose accurately and confidently.

The Ambulo 2400 Ambulatory Blood Pressure Monitoring (ABPM) system offers state-of-the-art innovation, accuracy, and reliability in a sleek and easy-to-use package. It is lightweight, comfortable, and does not interfere with daily activities. The 24-hour blood pressure measurements provide you with a full picture of each patient's blood pressure over the circadian cycle. Built-in actigraphy tracks activity level during the study period and supports the automatic determination of awake/asleep cycles.

Benefits of ABPM vs. Traditional Methods

	Home Blood Pressure	Clinic Blood Pressure	**Ambulo 2400 ABPM**
Assessing white coat hypertension	Limited	No	**Yes**
Determining true or mean BP	Yes	No	**Yes**
Identifying circadian or diurnal rhythm	No	No	**Yes**
Identifying nocturnal patterns	No	No	**Yes**
Evaluating the extent of the morning surge	Limited	No	**Yes**
Blood pressure variability	Limited	No	**Yes**
Evaluation of response to antihypertensive treatments	Yes	Limited	**Yes**
Determining time-dependent administration effects of treatments	Yes	No	**Yes**
Correlation of activity level with BP profile	No	No	**Yes**
Accuracy of patient recorded data	Limited	No	**Yes**

TRULY AFFORDABLE SOLUTION
State of the art technology and features at the most competitive prices

TRUSTED TECHNOLOGY
Patented oscillometric technology meets powerful Windows®-based software for setup, collection, analysis, and documentation

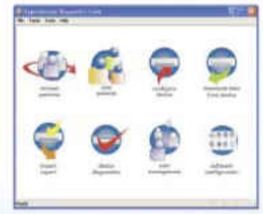
HIGHLY ACCURATE
Validated to both British Hypertension Society and AAMI SP-10 protocols

BUILT-IN ACTIGRAPHY
Automatic determination of asleep/awake cycles based on patented technology reduces cumbersome reliance on diaries, and enables synchronization of before/after studies in clinical review

PATIENT COMFORT IS KEY
Compact, lightweight, quiet, and comfortable operation increases patient compliance and produces detailed test results. EasyWear™ cuff allows for device to be directly worn on the cuff, eliminating clutter

EASY TO USE
Quick, easy hook-up and data capture; powerful yet simple analysis tools

SERVICE AND SUPPORT LEADER
One or two-year manufacturer's warranty with lifetime support from our friendly, knowledgeable, and action-oriented staff



Intuitive and Powerful Software

- Program the device, including "One Click Configuration", testing, and calibration
- Download measurements
- Track medications for each patient and study
- View graphs, statistics, and generate summary or detailed reports
- Compare studies to assess progress, including automatic asleep/awake pattern synchronization
- Import/Export data using industry-standard XML format
- Generate PDF reports for EMR/EHR applications
- HIPAA compliant

ASPM Recommendations & Billing Codes in Clinical Practice

CPT Code: **93784**

Medicare Reimbursement Range: **$52 - $98**

Indication	JNC-7	WHO-ISH
White coat hypertension*	•	•
Labile hypertension	•	•
Resistant hypertension	•	•
Hypotensive episodes	•	•
Postural hypertension	•	No

JNC-7: The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure.

WHO-ISH: 2003 World Health Organization (WHO)/ International Society of Hypertension (ISH) statement on management of hypertension

* Reimbursable in the US by the Centers for Medicare & Medicaid Services. Private providers reimburse for additional indications. Contact us for full billing and reimbursement information.

APPENDIX I: TIBA MEDICAL AMBULO 2400 FDA APPROVAL DOCUMENTS

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Food and Drug Administration
9200 Corporate Boulevard
Rockville MD 20850

APR 2 3 2008

Tiba Medical, Inc.
c/o Mr. Merat Bagha
President
2701 NW Vaughn St., Suite 470
Portland, OR 97201

Re: K080274
Trade/Device Name: Ambulo™ 2400
Regulation Number: 21 CFR 870.1130
Regulation Name: Noninvasive Blood Pressure Monitoring System
Regulatory Class: Class II (two)
Product Code: DXN
Dated: January 30, 2008
Received: February 1, 2008

Dear Mr. Bagha:

We have reviewed your Section 510(k) premarket notification of intent to market the device referenced above and have determined the device is substantially equivalent (for the indications for use stated in the enclosure) to legally marketed predicate devices marketed in interstate commerce prior to May 28, 1976, the enactment date of the Medical Device Amendments, or to devices that have been reclassified in accordance with the provisions of the Federal Food, Drug, and Cosmetic Act (Act) that do not require approval of a premarket approval application (PMA). You may, therefore, market the device, subject to the general controls provisions of the Act. The general controls provisions of the Act include requirements for annual registration, listing of devices, good manufacturing practice, labeling, and prohibitions against misbranding and adulteration.

If your device is classified (see above) into either class II (Special Controls) or class III (PMA), it may be subject to such additional controls. Existing major regulations affecting your device can be found in the Code of Federal Regulations, Title 21, Parts 800 to 898. In addition, FDA may publish further announcements concerning your device in the Federal Register.

Please be advised that FDA's issuance of a substantial equivalence determination does not mean that FDA has made a determination that your device complies with other requirements of the Act or any Federal statutes and regulations administered by other Federal agencies. You must comply with all the Act's requirements, including, but not limited to: registration and listing (21 CFR Part 807); labeling (21 CFR Part 801); good manufacturing practice requirements as set forth in the quality systems (QS) regulation (21 CFR Part 820); and if applicable, the electronic product radiation control provisions (Sections 531-542 of the Act); 21 CFR 1000-1050. This letter will allow you to begin marketing your device as described in your Section 510(k) premarket notification. The FDA finding of substantial equivalence of your device to a legally marketed predicate device results in a classification for your device and thus, permits your device to proceed to the market.

If you desire specific advice for your device on our labeling regulation (21 CFR Part 801), please contact the Center for Devices and Radiological Health's (CDRH's) Office of Compliance at (240) 276-0120. Also, please note the regulation entitled, "Misbranding by reference to premarket notification" (21CFR Part 807.97). For questions regarding postmarket surveillance, please contact CDRH's Office of Surveillance and Biometric's (OSB's) Division of Postmarket Surveillance at 240-276-3474. For questions regarding the reporting of device adverse events (Medical Device Reporting (MDR)), please contact the Division of Surveillance Systems at 240-276-3464. You may obtain other general information on your responsibilities under the Act from the Division of Small Manufacturers, International and Consumer Assistance at its toll-free number (800) 638-2041 or (240) 276-3150 or at its Internet address http://www.fda.gov/cdrh/industry/support/index.html.

Sincerely yours,

B Zimmerman for

Bram D. Zuckerman, M.D.
Director
Division of Cardiovascular Devices
Office of Device Evaluation
Center for Devices and
Radiological Health

Enclosure

APPENDIX J: PARTICIPANT INFORMATION SHEET

Study ID:_________ Device Serial # ___________

Gender:_________ Age: _______

Height (inches): _______ Weight (pounds): ________

Waist Circumference (inches): ________

Race

1) American Indian or Alaska Native

2) Asian

3) Black or African American

4) Native Hawaiian or Other Pacific Islander

5) White or Caucasian

6) Other (Specify):___________________

Ethnicity

1) Hispanic

2) Non-Hispanic

Family History of Hypertension (mother or father only)

1) Yes 2) No

APFT Score________ Date:__________

APPENDIX K: STATE-TRAIT ANXIETY INVENTORY

mind garden

www.mindgarden.com

To whom it may concern,

This letter is to grant permission for the above named person to use the following copyright material;

Instrument: ***State-Trait Anxiety Inventory for Adults***

Authors: ***Charles D. Spielberger, in collaboration with R.L. Gorsuch, G.A. Jacobs, R. Lushene, and P.R. Vagg***

Copyright: ***1968, 1977 by Charles D. Spielberger***

for his/her thesis research.

Five sample items from this instrument may be reproduced for inclusion in a proposal, thesis, or dissertation.

The entire instrument may not be included or reproduced at any time in any other published material.

Sincerely,

Robert Most
Mind Garden, Inc.
www.mindgarden.com

Appendix K

State-Trait Anxiety Inventory

	NOT AT ALL	SOMEWHAT	MODERATELY SO	VERY MUCH SO
1. I feel self-confident	1	2	3	4
2. I feel nervous	1	2	3	4
3. I am jittery	1	2	3	4
4. I feel indecisive	1	2	3	4
5. I am relaxed	1	2	3	4

APPENDIX L: PAINTBALL PERCEIVED STRESS QUESTIONNAIRE

Paintball Exercise Questionnaire

Study ID #_________

Instructions: Using a scale from 0 to 10, rank your level of stress to the three questions.

0 = Not Stressed At All   5 = Moderately Stressed   10 = Extremely Stressed

1) What was your level of stress yesterday before the paintball exercise?

0 1 2 3 4 5 6 7 8 9 10

2) What was your level of stress during the paintball exercise?

0 1 2 3 4 5 6 7 8 9 10

3) What was your level of stress when you were placed in the leadership position during the paintball exercise?

0 1 2 3 4 5 6 7 8 9 10

4) What is your stress level now?

0 1 2 3 4 5 6 7 8 9 10

APPENDIX M: ARMY PHYSICAL FITNESS TEST SCORE CARD

Army Physical Fitness Test Scorecard

For use of this form, see FM 21-20; the proponentagency is TRADOC

NAME (LAST, FIRST MIDDLE)	
SSN	GENDER
UNIT	

TEST ONE	TEST TWO	TEST THREE	TEST FOUR
DATE / GRADE / AGE	DATE / GRADE / AGE	DATE / GRADE / AGE	DATE / GRADE / AGE
HEIGHT (IN INCHES) / BODY COMPOSITION: WEIGHT: ____ lbs GO / NO-GO ☐ ☐; BODY FAT: ____ % GO / NO-GO ☐ ☐	HEIGHT (IN INCHES) / BODY COMPOSITION: WEIGHT: ____ lbs GO / NO-GO ☐ ☐; BODY FAT: ____ % GO / NO-GO ☐ ☐	HEIGHT (IN INCHES) / BODY COMPOSITION: WEIGHT: ____ lbs GO / NO-GO ☐ ☐; BODY FAT: ____ % GO / NO-GO ☐ ☐	HEIGHT (IN INCHES) / BODY COMPOSITION: WEIGHT: ____ lbs GO / NO-GO ☐ ☐; BODY FAT: ____ % GO / NO-GO ☐ ☐
PU RAW SCORE / INITIALS / POINTS	PU RAW SCORE / INITIALS / POINTS	PU RAW SCORE / INITIALS / POINTS	PU RAW SCORE / INITIALS / POINTS
SU RAW SCORE / INITIALS / POINTS	SU RAW SCORE / INITIALS / POINTS	SU RAW SCORE / INITIALS / POINTS	SU RAW SCORE / INITIALS / POINTS
2MR RAW SCORE / INITIALS / POINTS	2MR RAW SCORE / INITIALS / POINTS	2MR RAW SCORE / INITIALS / POINTS	2MR RAW SCORE / INITIALS / POINTS
ALTERNATE AEROBIC EVENT: EVENT ____ TIME ____ GO ☐ NO-GO ☐ / TOTAL POINTS	ALTERNATE AEROBIC EVENT: EVENT ____ TIME ____ GO ☐ NO-GO ☐ / TOTAL POINTS	ALTERNATE AEROBIC EVENT: EVENT ____ TIME ____ GO ☐ NO-GO ☐ / TOTAL POINTS	ALTERNATE AEROBIC EVENT: EVENT ____ TIME ____ GO ☐ NO-GO ☐ / TOTAL POINTS
NCOIC/OIC SIGNATURE	NCOIC/OIC SIGNATURE	NCOIC/OIC SIGNATURE	NCOIC/OIC SIGNATURE
COMMENTS	COMMENTS	COMMENTS	COMMENTS

SPECIAL INSTRUCTION: USE INK

LEGEND: PU - PUSHUPS; SU - SIT UPS; 2MR - 2 MILE RUN; APFT - ARMY PHYSICAL FITNESS TEST

Data Required by the Privacy Act of 1974

Title DA form 705
Authority 5 USC Section 301
Disclosure of requested information is mandatory.

Individuals not providing information cannot be rated/scored. The principal purpose and routine use of this information are to maintain a record of individual scores on physical fitness events.

DA FORM 705, JUNE 1999 DA FORM 705, JUN 1998, MAY BE USED USAPA V1.00

APPENDIX N: RECRUITMENT SCRIPT

Good morning, my name is MeLisa Gantt and I'm one of the PhD students from the College of Nursing.

I'm here to ask for your support in a research study. As you know, we've all experienced some type of stress. I can remember the stress that I had when I was a junior in college like you. If we're not careful stress can impact our health, especially our cardiovascular system. As future leaders of soldiers who will be experiencing all types of stress (ranging from family issues to being in combat), it is important for you to be aware and understand how stress affects you. Your participation in the study will help to provide information related to the cardiovascular response to stress, and may provide evidence for the need of preventative cardiovascular measures for soldiers.

I have a unique opportunity for you to contribute the military health research looking at stress and blood pressure.

During the Spring Semester, the ROTC battalion will be scheduling simulated combat exercises. I would like to conduct research on cardiovascular response using paintball during this scheduled time. This will not only be an opportunity to get out and have fun, but it will also help you prepare for the big field exercise that you have scheduled later in the spring. All that I ask is that you wear this small ambulatory blood pressure device, the size of an iPod, for 48 continuous hours. This device will record your blood pressure and pulse at different interval while you are awake and asleep. Forty-eight hours is necessary because it allows me to observe what your blood pressure is doing before, during and after stress.

If you agree to participate, you will get a personalized state of the art report of your cardiovascular health, a blood pressure information sheet and tracking from, and lunch will be provided.

If you do not want to be a part of the study, you will participate in the normal training exercise with the rest of the battalion. This will not be reflected in your grade, nor with your current or future participation in ROTC or the military.

I have posted several flyers throughout the department along with signup sheets containing my contact information if you have any questions.

I hope to hear from you soon and look forward to playing paintball with you.

APPENDIX O: RECRUITMENT SCREENING TOOL

Name:____

Phone Number:_________________________________

Date of Birth: _________________________________

Are you currently under a ROTC contract? No _____ Yes _____

List all medications and/or supplements you are currently taking?

(include any "over the counter" medication)

Have you ever been diagnosed with any disease involving your cardiovascular system?

(example: high blood pressure, heart murmur, arteriosclerosis, etc.)

No _____ Yes _____

If yes, explain:

Would anything prohibit you from wearing an ambulatory blood pressure monitor for 48 continuous hours?

No _____ Yes _____

APPENDIX P: XTREME PAINTBALL WAIVER

READ AND COMPLETE ALL BLANKS - FRONT & BACK

NAME OF PARTICIPANT Birth date

Street Address

City State Zip

Telephone # Email (for special promotions of XPX)

RENTALS

Cashier will mark the boxes during check-in process.

- ☐ Marker
- ☐ Air Tank
- ☐ Goggle
- ☐ Pod Pack
- ☐ Coverall
- ☐ Chest Armor
- ☐ Barrel Bag
- ☐ Neck Guard
- ☐ Hopper

SAFETY RULES (must be read by participant to play or observe)

WE MAINTAIN THE RIGHT TO REFUSE PARTICIPATION TO ANYONE ON ANY GROUNDS DEEMED APPLICABLE BY US. THERE ARE NO REFUNDS OF FIELD OR RENTAL FEES OR PAINTBALLS IF YOU ARE ASKED TO LEAVE BECAUSE OF RULE VIOLATIONS.

1. Always wear approved goggles at shooting range and in or near playing field. Not adhering to this rule is cause for immediate dismissal from the games. In goggle required areas the goggle/mask may not be removed for any reason which includes but is not limited to: fogging, painted lenses or during an injury.
2. A barrel-blocking device must be used when not shooting or when you are not in an active field of play.
3. Always look when unscrewing a bottle from the paintball gun. If the valve starts to unscrew from the bottle. STOP!
4. Never shoot at anyone who is not wearing approved eye protection or anyone whose safety gear is not in place.
5. A player is emphatically disallowed from shooting at any other player showing a neutrality symbol, any non-player, any referee, or any animal or bird.
6. No player may shoot at any person, object or animal outside the perimeter of the active playing field.
7. No player may intentionally shoot at any other player's head or face.
8. Observe all safety rules applicable to firearms when handling paintball guns or other gas-powered devices capable of launching projectiles.
9. Never shoot anything from a paintball gun except the water-soluble paintballs provided.
10. All paintball guns must be chronographed prior to use in play and shall not exceed a velocity of 300 feet per second.
11. A referee may touch or move a player during a paint check, a neutral call, a "playing on" after eliminated or to break up a fight.
12. Never shoot at another person in anger or with intent to cause harm.
13. Firearms, knives and explosives are strictly forbidden.
14. No physical confrontation between players, i.e. hand-to-hand combat, taking prisoners, etc. is permitted.
15. Consumption of alcohol or drugs on the premises or in the parking area is prohibited.
16. Smoking is allowed only in the staging area.
17. National, regional, state, provincial and local laws apply.
18. Paintball guns or other gas powered devices used in paintball games must not have a paintball or other projectile chambered while in the staging or parking area.
19. Never look down the barrel to see if it's dirty. Just squeegee the barrel or use your fingers to check it.
20. Paintball guns without approved barrel blocking devices must be carried on safe, with the barrel pointing to the ground while in the staging, neutral or parking areas. No waving them around in a neutral area.
21. No going up trees (or on roofs, if applicable)
22. No discharging or dry firing of paintball guns is allowed in any neutral or non-playing area.
23. Do not use a paintball gun until you have been versed on its use and understand such use.
24. Do not shoot across neutral or staging areas or parking lots.
25. You cannot play, use the target range or be a spectator without signing a waiver/release of liability

PARTICIPANT RELEASE / WAIVER OF LIABILITY / ASSUMPTION OF RISK / INDEMNITY / HOLD HARMLESS AGREEMENT, CONSENT FOR MEDICAL TREATMENT AND PARENTAL CONSENT APPLICATION TO PLAY OR OBSERVE PAINTBALL (COVENANT NOT TO SUE)

THE UNDERSIGNED "ADULT", being of at least 18 years of age, signing on behalf of himself/herself and/or signing as parent or legal guardian on behalf of minor child named below (Adult and Child are known collectively as "Participant") has asked XTREME PAINTBALL XPERIENCE, LLC to be allowed to participate in PAINTBALL and acknowledges that the game involves physical exertion and other risks, known and unknown and may result in injury to the undersigned or others playing the game, even if all safety rules are followed;

1. Is aware of the possibility of risks of injury or illness, including, but not limited to bodily injury, fractures, eye injury, blindness, partial or total paralysis, disease fractures, being hit by a paintball, falling, tripping, being hurt by a wild animal, snake bite, heat stroke, heart attack, hypothermia, getting lost in the wilderness, being shot by hunters, being caught in a rock, snow or mud slide, insect bites & stings, poisonous, cutting, stinging or piercing plants, being struck by lightening, improper use,

CONTINUED ON REVERSE SIDE

malfunction or operation of equipment by the undersigned or any other player and/or others not following the safety rules. Players will be exposed to both natural and manmade hazards. The possibility of permanent disability or death does exist;

2. Agrees to play the game according to the rules which have been explained, posted and provided and to follow directions given by any game referees;
3. Warrants and acknowledges that his / her physical condition is excellent and his / her mental state is sufficiently stable to enable him / her to participate safely in the game. This includes not being on any medications that would pose a risk to him or her under physically, exerting conditions.
4. Agrees to use any paintball equipment in a manner which will not cause injury or damage to himself / herself or others playing;
5. Certifies that he / she is 18 or over 18 years old;
6. Authorizes use of photos, videos, name, comments, game results, etc. for promotional purposes;
7. Understands and agrees to follow all safety rules and procedures and that such rules and procedures not followed by others could result in my injury or death;
8. Understands that serious and permanent eye injury, including loss of eyesight, can occur if approved paintball safety eyewear is not worn in any area where paintball guns may be intentionally or accidentally discharged. I understand it is my responsibility to wear approved safety eyewear and I accept that responsibility.
9. Understands that the safety eyewear can fog or become dirty, and agrees that despite any, or other, such problems that he / she will keep them securely fastened to protect the eyes and will not remove them while on the playing field, at the chronograph, at the target range or in any other area where he / she might be struck by a paintball, other gas powered projectile device used in paintball or by the dispersing of a paint grenade.
10. Understands that loss of hearing from an ear shot, disorientation and injury from throat, groin, head or ear shots can occur if proper safety equipment is not worn to protect these areas, and understands it is his / her responsibility to wear or not wear such items.
11. ADULT authorizes the RELEASED PARTIES and/or their authorized personnel to call for medical care, treatment, procedure or transport to a medical facility should participant be deemed by the opinion of authorized personnel to need such care. RELEASED PARTIES shall not have further responsibility upon participants transport to facility or hospital. Furthermore, all costs for such emergency and/or medical care and/or transport shall be borne solely by the PARTICIPANT. In the event the CHILD requires medical care, it is understood every effort will be made to notify ADULT. Consent is hereby given to authorized representatives, emergency care giver and/or physicians to exercise their best judgment in undertaking such care.

IN CONSIDERATION of being permitted to play, watch or participate in paintball, the undersigned, on behalf of himself / herself, his / her successors or assigns, hereby releases and forever discharges XTREME PAINTBALL XPERIENCE, LLC, land owners, land lease holders or managers, equipment distributors, advertisers, sponsors, and their successors, next of kin, assigns, subrogors, employees, volunteers, officers, directors, agents and franchisees, dealers or operators both jointly and severally, from any and all actions, covenants, claims and demands for damages, costs, expenses (including attorneys' fees), loss or injury, however arising, including negligence, whether caused in whole or part, of XTREME PAINTBALL XPERIENCE, LLC, employees, owners, agents, participants or others which may have been or may be sustained by the undersigned in any way, foreseeable and unforeseeable, relating to or arising out of the participation in paintball activities or using or being around others using paintball equipment, including but not limited to, the manufacture, selection, delivery, possession, use, or operation of the equipment or the natural environment. I acknowledge that if I believe event conditions are unsafe, I will immediately discontinue participation. The undersigned desires and agrees to assume any and all risks.

THIS DOCUMENT IS INTENDED TO BE A LEGALLY BINDING CONTRACT RELIEVING THE GAME OPERATORS, THEIR EMPLOYEES, EQUIPMENT SUPPLIERS AND OTHERS MENTIONED, FROM LIABILITY FOR INJURY TO YOU. IF YOU HAVE ANY DOUBTS CONCERNING ANY ASPECT OF ITS CONTENTS, CONSULT AN ATTORNEY BEFORE SIGNING IT. THIS HOLD HARMLESS AGREEMENT COVERS ALL PAINTBALL ACTIVITIES OR EVENTS I PARTICIPATE IN HEREAFTER.

I, on behalf of myself, my personal representatives, my heirs, hereby voluntarily agree to the above release and acknowledge the receipt of the referenced safety rules. I have read each and every item of this RELEASE / WAIVER OF LIABLILITY, ASSUMPTION OF RISK, HOLD HARMLESS, PARENTAL CONSENT, COVENANT NOT TO SUE, CONSENT FOR MEDICAL TREATMENT AND INDEMNITY AGREEMENT. I understand that I have given up substantial rights by signing below and have signed it feely and without any inducement or assurance of any nature and intend it be a complete and unconditional release of all liability to the greatest extend allowed by law and agree that if any portion of this agreement is held to be invalid or unenforceable, the balance, notwithstanding, shall continue in full force and effect. I understand this agreement will apply for each and every day of my or minor/s name below, participation in any activity without requiring an additional form until such time, I the participant, revokes it in writing and such writing is accepted, in writing, by an authorized representative.

I understand what each item means, will participate and/or allow minor child's participation, in spite of the herein mentioned risks and I agree to abide by the terms of this Waiver. By signing, I agree it is my intention to exempt and relieve, release, waive, discharge, hold harmless, defend and indemnify XTREME PAINTBALL XPERIENCE, LLC, for personal injury, property damage or wrongful death, for any cause.

IN WITNESS WHEREOF, the undersigned has executed this Agreement on the _____ day of ______________, 20__________

Signature of Participant if over 18 or Parent/Legal Guardian of a Minor	Print name	Witness

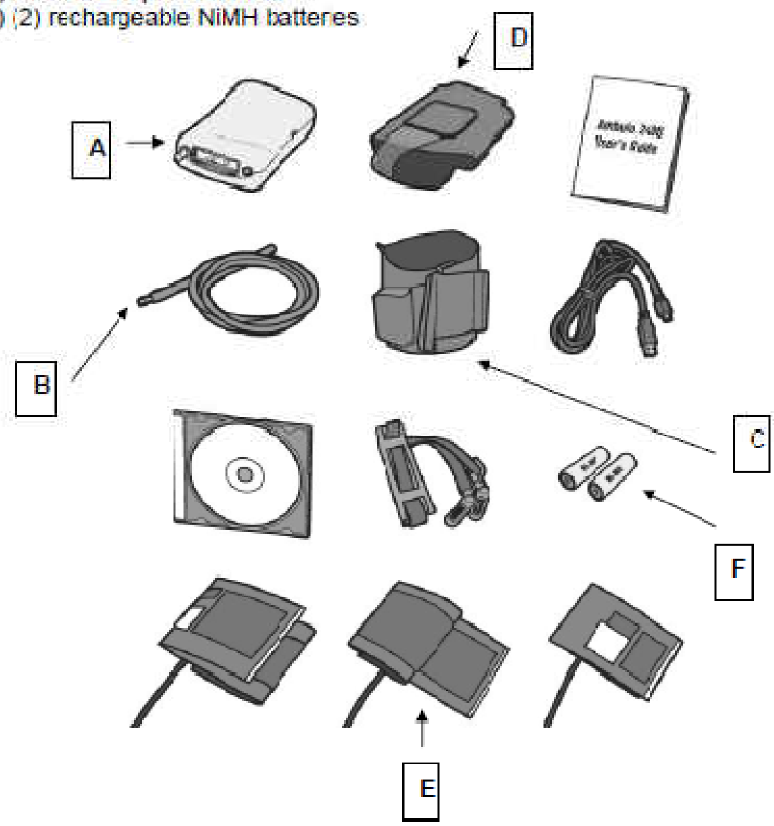
READ THE SAFETY RULES & ATTEND A SAFETY ORIENTATION REV 08/27/2009

APPENDIX Q: PARTICIPANT INSTRUCTION SHEET

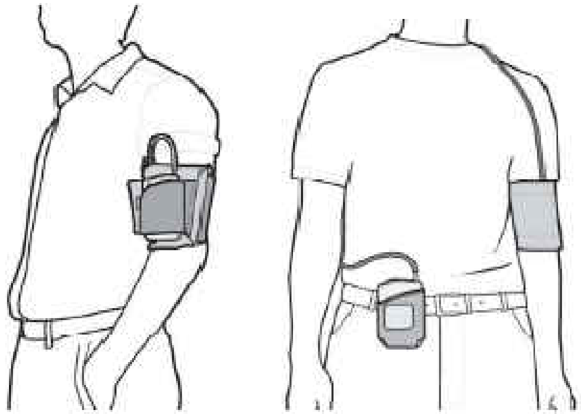
Instructions on Wearing the
Tiba Medical Ambulatory Blood Pressure Device

You have been fitted with the Tiba Medical Ambulo 2400 ambulatory blood pressure device. This device will take your blood pressure every 30 minutes during your awake hours and 60 minutes during your sleep hours.

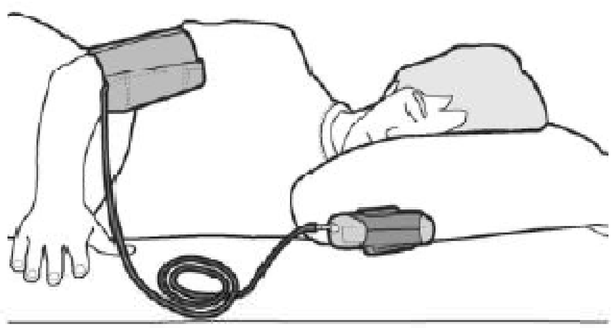
The system includes:
A) Ambulatory blood pressure device
B) Extension air hoses
C) Easy wear cuff
D) Carrying pouch with air clip
E) Adult blood pressure cuff
F) (2) rechargeable NiMH batteries



During your awake hours the device can be worn two ways:

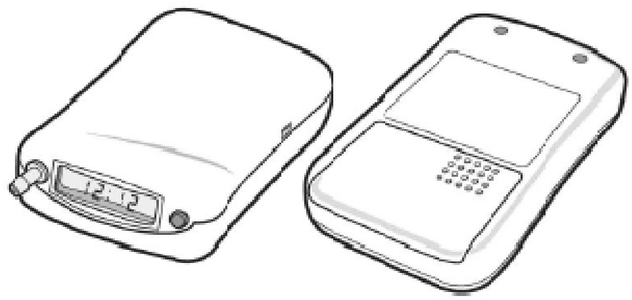


During your asleep hours the device can be worn:



NOTE: Follow the verbal instructions given regarding the adding and removal of the extension hose.

Day 1: Within two hours of waking, place the blood pressure cuff on your non-dominate arm so that the artery indicator rests on the brachial artery as demonstrated at the interview. Apply the ECG electrode to your bare skin directly above the cuff and connect the electrode to the cuff snap. Whether you wear the device on your arm or clipped to your belt, be sure that the air tube on the device is pointing up.



Go about your day as you normally would with the exception of any strenuous exercise. While a measurement is in progress, you should relax your cuffed arm. Any movement for the duration of the measurement should be minimized, ideally movement should cease altogether. If you need to remove the device for any reason, press and hold the button located by the LCD screen for three seconds. The LCD will alternate between displaying the current time and PAUSE. Once you reapply the device, press and hold the button again for three seconds to return to automatic mode. At bedtime, you may wear the device as illustrated earlier.

Day 2: Be sure that the device remains on for first two hours upon awakening. Once at the paintball site, your device will be set to obtain your blood pressure every 10 minutes. At the end of the exercise, your device will be set back to the initial setting (every 30 minutes while awake and every 60 minutes while asleep). As in Day 1, go about the remainder of your day as you normally would with the exception of any strenuous exercise. At bedtime place the device the same way as in Day 1.

Day 3: Be sure that the device remains on for first two hours upon awakening. After the completion of the two hours, you may remove and turn off the device. The investigator will arrange to collect the device and all of its components.

IMPORTANT!!!

In the event that a measurement needs to be stopped in progress, press the button located by the LCD screen to deflate the cuff.

Avoid dropping the device, or subjecting it to shock and/or vibration

If you receive any error code on the LCD screen, text of phone MeLisa Gantt at 407-516-1009 as soon as possible.

IMPORTANT: The device must be worn during the following times:

Day	**Day of Measurement**	**Time**
Day 1 (afternoon/evening)	Day before exercise	1200-1600 hrs
Day 1 (night)	Day before exercise	While asleep
Day 2 (morning)	Day of exercise	From time awaken for 2 hours
Day 2 (afternoon/evening)	Day of exercise	1200-1600 hrs
Day 2 (evening)	Day of exercise	1600-1700 hrs
Day 2 (night)	Day of exercise	While asleep
Day 3 (morning)	Day after exercise	From time awaken for 2 hours

APPENDIX R: TIBA MEDICAL AMBULO 2400 CARDIOVASCULAR REPORT 1

My Clinic Name
My Web Site Address

My Custom Header

Patient Information

Name	Demc - Whitecoat Hypertension	**Primary physician**	Dr. Bill Jones
Date of birth	October 10, 1972	**Interpreting physician**	Dr. Mark Smith

Statistical Overview

Start Time	January 29, 2008, 9:40
Stop Time	January 30, 2008, 8:40
Duration	23 Hours
Measurements	36 Total/36 Valid

Complete (36 Total/36 Valid)	Min	Mean	Max	StdDev
Systolic	98	115.1	133	9.0
Diastolic	58	67.6	78	5.1
Pulse	70	78.2	90	4.6
Systolic > 140 mmHg	0.0 %			
Diastolic > 90 mmHg	0.0 %			

Mean Difference between Awake and Asleep	Δ mmHg	% drop
Systolic	14.2	11 %
Diastolic	6.9	9 %
Pulse	0.9	1 %

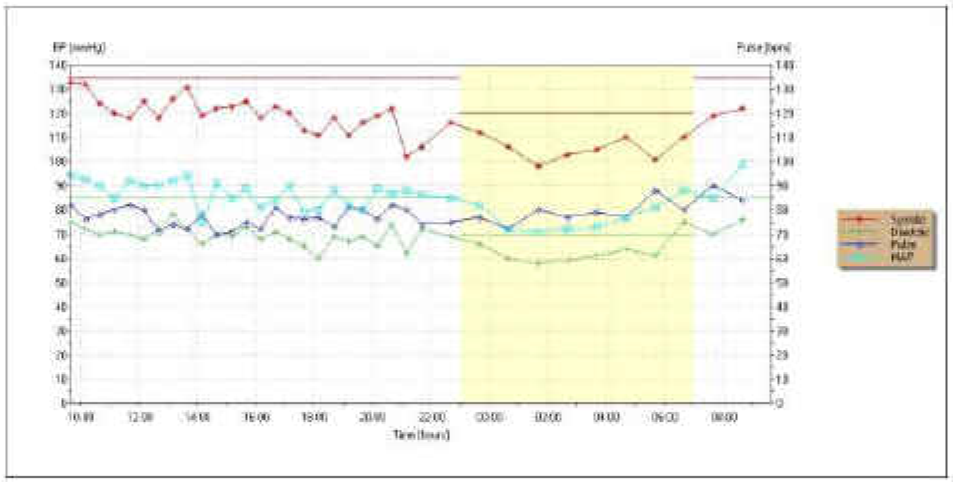
Awake (28 Total/28 Valid)	Min	Mean	Max	StdDev
Systolic	102	119.6	133	8.5
Diastolic	60	69.9	78	4.5
Pulse	70	77.9	90	4.7
Systolic > 135 mmHg	0.0 %			
Diastolic > 85 mmHg	0.0 %			

Asleep (8 Total/8 Valid)	Min	Mean	Max	StdDev
Systolic	96	105.6	112	11.2
Diastolic	58	63.0	75	7.4
Pulse	72	78.8	88	4.6
Systolic > 120 mmHg	0.0 %			
Systolic > 70 mmHg	12.5 %			

My Clinic Name
My Web Site Address

Name	Demo - Whitecoat Hypertension	**Primary physician**	Dr. Bill Jones
Date of birth	10-10-1972	**Interpreting physician**	Dr. Mark Smith

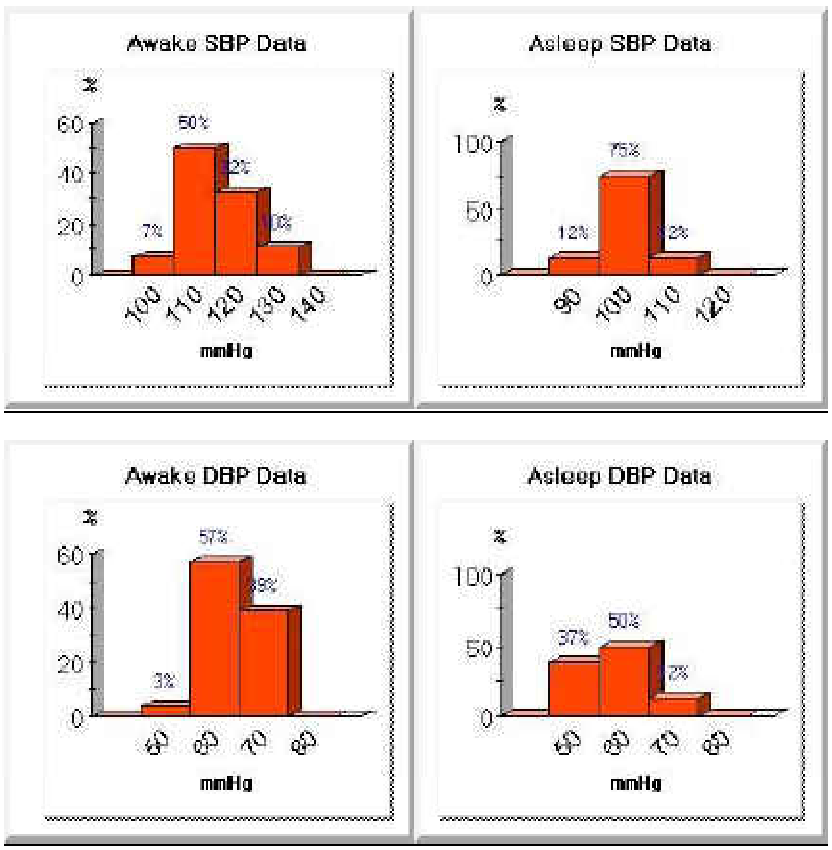
Blood Pressure Graph



My Clinic Name
My Web Site Address

Name	Demo - Whitecoat Hypertension	**Primary physician**	Dr. Bill Jones
Date of birth	10-10-1972	**Interpreting physician**	Dr. Mark Smith

Histograms



My Clinic Name
My Web Site Address

Name	Demo - Whitecoat Hypertension	Primary physician	Dr. Bill Jones
Date of birth	10-10-1972	Interpreting physician	Dr. Mark Smith

Measurement Data

January 29, 2008

Time	Events	Systolic mmHg	Diastolic mmHg	Pulse bpm	MAP	Remarks	Event Description
9:40		133	75	82	94		Scheduled measurement
10:10		132	72	76	93		Scheduled measurement
10:40		124	70	78	90		Scheduled measurement
11:10		120	71	80	85		Scheduled measurement
11:40		118	70	82	92		Scheduled measurement
12:10		125	68	80	90		Scheduled measurement
12:40		118	72	71	90		Scheduled measurement
13:10		126	78	74	92		Scheduled measurement
13:40		131	72	72	94		Scheduled measurement
14:10		119	66	78	75		Scheduled measurement
14:40		122	70	70	91		Scheduled measurement
15:10		123	69	71	85		Scheduled measurement
15:40		125	73	75	89		Scheduled measurement
16:10		118	68	72	81		Scheduled measurement
16:40		123	71	81	84		Scheduled measurement
17:10		120	68	77	90		Scheduled measurement
17:40		113	65	76	79		Scheduled measurement
18:10		111	60	77	80		Scheduled measurement
18:40		118	69	73	88		Scheduled measurement
19:10		111	67	81	82		Scheduled measurement
19:40		116	69	80	80		Scheduled measurement
20:10		119	65	76	89		Scheduled measurement
20:40		122	74	82	87		Scheduled measurement
21:10		102	62	80	88		Scheduled measurement
21:40		106	72	74	86		Scheduled measurement

My Clinic Name
My Web Site Address

Name	Demo - Whitecoat Hypertension	**Primary physician**	Dr. Bill Jones
Date of birth	10-10-1972	**Interpreting physician**	Dr. Mark Smith

January 29, 2008

Time	Events	Systolic mmHg	Diastolic mmHg	Pulse bpm	MAP	Remarks	Event Description
22:40		116	69	75	85		Scheduled measurement
23:40		112	66	77	82		Scheduled measurement

January 30, 2008

Time	Events	Systolic mmHg	Diastolic mmHg	Pulse bpm	MAP	Remarks	Event Description
0:40		106	60	72	72		Scheduled measurement
1:40		98	58	80	71		Scheduled measurement
2:40		103	59	77	72		Scheduled measurement
3:40		105	61	79	73		Scheduled measurement
4:40		110	64	77	77		Scheduled measurement
5:40		101	61	88	81		Scheduled measurement
6:40		110	75	80	88		Scheduled measurement
7:40		119	70	90	85		Scheduled measurement
8:40		122	76	84	99		Scheduled measurement

My Custom Footer Page 5 of 7

My Clinic Name
My Web Site Address

Name	Demo – Whitecoat Hypertension	**Primary physician**	Dr. Bill Jones
Date of birth	10-10-1972	**Interpreting physician**	Dr. Mark Smith

<u>Diagnostic summary</u>

An Ambulatory Blood Pressure Monitoring procedure was conducted upon Demo - Whitecoat Hypertension beginning at 9:40 on January 29, 2008 and ending at 8:40 on January 30, 2008. Out of the 36 collected blood pressure readings, 36 were determined to be valid measurements without error. The results of the procedure are as follows:

-The Maximum systolic blood pressure that was recorded was 133 mmHg, and occurred at 9:40 (January 29, 2008).

-The Maximum diastolic blood pressure that was recorded was 78 mmHg, and occurred at 13:10 (January 29, 2008).

-The Maximum pulse rate that was recorded was 90 BPM, and occurred at 7:40 (January 30, 2008).

-The Minimum systolic blood pressure that was recorded was 98 mmHg, and occurred at 1:40 (January 30, 2008).

-The Minimum diastolic blood pressure that was recorded was 58 mmHg, and occurred at 1:40 (January 30, 2008).

-The Minimum pulse rate that was recorded was 70 BPM, and occurred at 14:40 (January 29, 2008).

Systolic Synopsis:

For all measurements, 0.0 % of systolic blood pressure readings exceeded the set limit of 140 mmHg. While the patient was awake, 0.0 % of systolic readings exceeded the set limit of 135 mmHg. While the patient was asleep, 0.0 % of systolic readings exceeded the set limit of 120 mmHg.

Diastolic Synopsis:

For all measurements, 0.0 % of diastolic blood pressure readings exceeded the set limit of 90 mmHg. While the patient was awake, 0.0 % of diastolic readings exceeded the set limit of 85 mmHg. While the patient was asleep, 12.5 % of diastolic readings exceeded the set limit of 70 mmHg.

My Clinic Name
My Web Site Address

Name	Demo - Whitecoat Hypertension	**Primary physician**	Dr. Bill Jones
Date of birth	10-10-1972	**Interpreting physician**	Dr. Mark Smith

Medication

Medication	Dosage	Frequency	Notes
No medication Entered			

Notes

My custom notes here

My Custom Footer   Page **7** of **7**

APPENDIX S: TIBA MEDICAL AMBULO 2400 CARDIOVASCULAR REPORT 2

My Clinic Name
My Web Site Address

ABPM Comparison Report

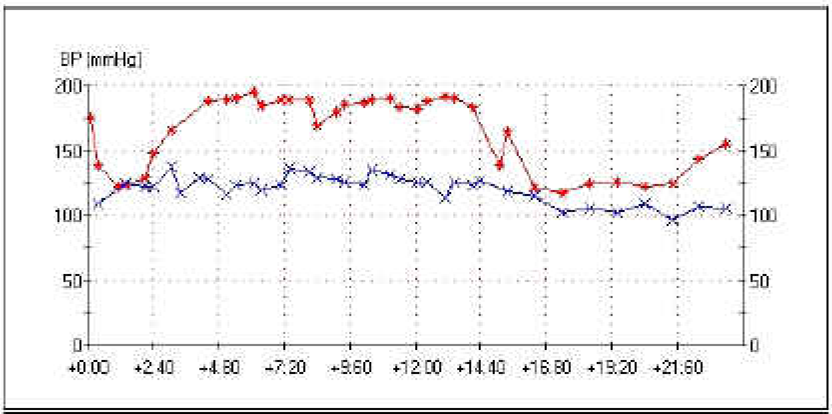
Patient Information

Patient Name	Demo - Hypertensive	Primary Physician	Dr. Bill Jones, MD
Date of Birth	10-10-1972	Interpreting Physician	Dr. Mark Smith, MD

Study Details 1 - Start Date : January 29, 2008, Start Time : 17:40, Awake time : 8:00, Stop Date : January 30, 2008, Stop Time : 17:10, Asleep time : 23:00

Study Details 2 - Start Date : February 01, 2008, Start Time : 19:40, Awake time : 7:00, Stop Date : February 02, 2008, Stop Time : 19:10, Asleep time : 23:00

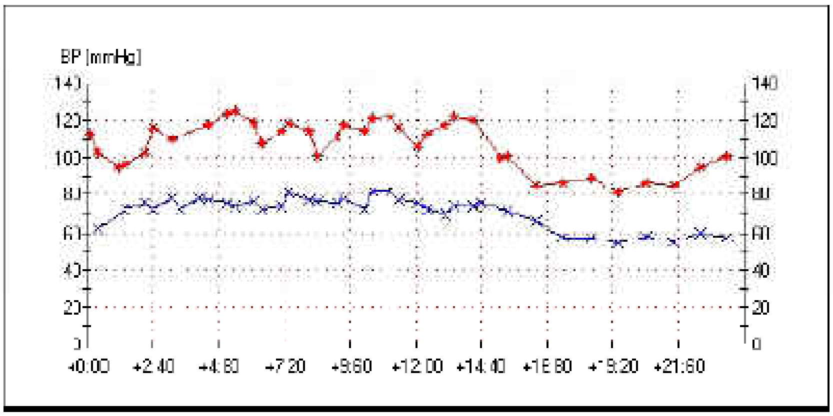
Systolic



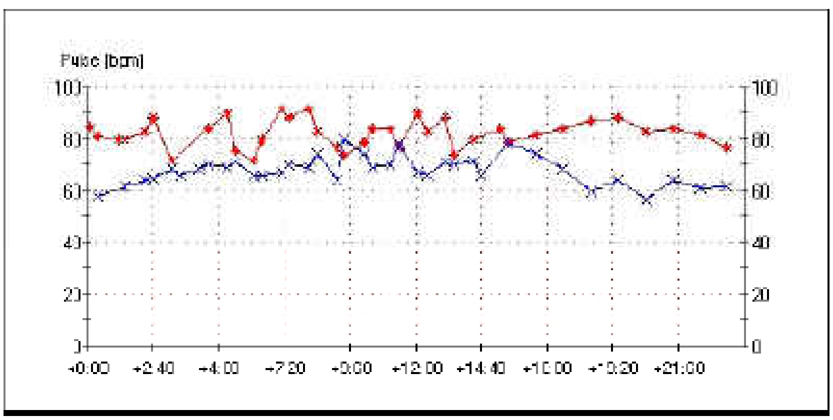
My Clinic Name
My Web Site Address

Patient Name	Demo - Hypertensive	**Primary Physician**	Dr. Bill Jones, MD
Date of Birth	10-10-1972	**Interpreting Physician**	Dr. Mark Smith, MD

Diastolic



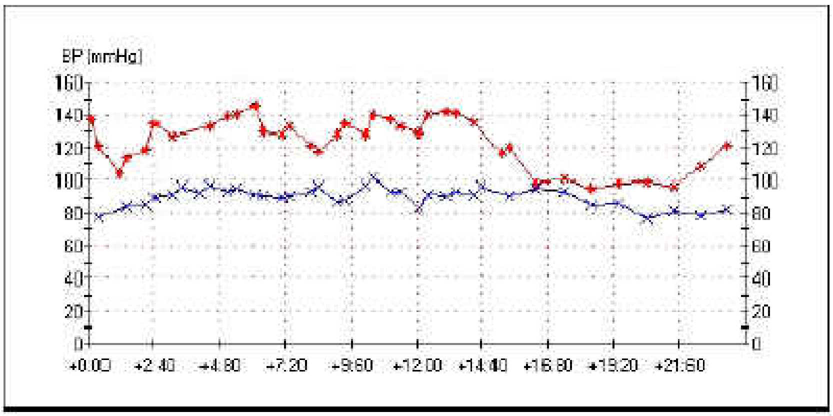
Pulse



My Clinic Name
My Web Site Address

Patient Name	Demo - Hypertensive	**Primary Physician**	Dr. Bill Jones, MD
Date of Birth	10-10-1972	**Interpreting Physician**	Dr. Mark Smith, MD

MAP



Medication Comparison

Study Details 1

Medication	Dosage	Frequency	Notes
No medication Entered			

Study Details 2

Medication	Dosage	Frequency	Notes
No medication Entered			

APPENDIX T: AMERICAN HEART ASSOCIATION BLOOD PRESSURE INSTRUCTIONS, TRACKER, AND WALLET CARD

BLOOD PRESSURE TRACKER – INSTRUCTIONS

American Heart Association

Learn and Live

- You should have your monitor's accuracy tested once a year by a healthcare professional.
  Date of last test: ____________
- Make sure the cuff fits: measure around your upper arm and choose a monitor that comes with the correct size cuff.
- It's important to take the readings at the same time each day, such as morning and evening, or as your healthcare professional recommends.

- Don't smoke, drink caffeinated beverages or exercise within the 30 minutes before measuring your blood pressure.
- Sit with your back straight and supported (on a dining chair, for example, rather than a sofa). Your feet should be flat on the floor; don't cross your legs. Your arm should be supported on a flat surface (such as a table) with the upper arm at heart level. Make sure the middle of the cuff is placed directly over your brachial artery as shown in the picture or your monitor's instructions, or have your healthcare provider show you how.
- Each time you measure, take two or three readings, one minute apart, and record all the results. Your doctor can calculate your average blood pressure from all of your readings, tell you what category you fall into, look at all your risk factors and give you a blood pressure goal.

American Heart Association recommended blood pressure levels

Blood Pressure Category	Systolic (mm Hg)		Diastolic (mm Hg)
Normal	less than 120	and	less than 80
Prehypertension	120–139	or	80–89
High			
Stage 1	140–159	or	90–99
Stage 2	160 or higher	or	100 or higher

Blood pressure higher than 180/110 mm Hg is an emergency. Call 9-1-1 immediately. If 9-1-1 is not available, have someone drive you to the nearest emergency facility immediately.

Heart rate or pulse is the number of times your heart beats per minute. The average resting heart rate is 60–80 beats per minute, but it's generally lower in physically fit people and it usually rises with age.

www.AmericanHeart.org/HBP

BLOOD PRESSURE TRACKER – PRINTABLE TRACKER

INSTRUCTIONS:

American Heart Association

Learn and Live

- Take your pressure at the same time each day, such as morning or evening, or as your healthcare professional recommends.
- Sit with your back straight and supported and your feet flat on the floor.
- Your arm should be supported on a flat surface with the upper arm at heart level.
- Make sure the middle of the cuff is placed directly over your brachial artery. Refer to the Instructions page of this tracker for a picture, or check your monitor's instructions, or have your healthcare provider show you how.
- Each time you measure, take two or three readings, one minute apart, and record all the results.

NAME:____________________ MY BLOOD PRESSURE TARGET GOAL IS:___/____mm Hg

DATE/TIME	READING 1		READING 2		READING 3		COMMENTS
	BLOOD PRESSURE	HEART RATE (PULSE)	BLOOD PRESSURE	HEART RATE (PULSE)	BLOOD PRESSURE	HEART RATE (PULSE)	
EXAMPLE 1/1/08 8:00pm	132/85 mm Hg	81 Beats Per Min.	130/80 mm Hg	70 Beats Per Min.	126/80 mm Hg	72 Beats Per Min.	at pharmacy
	/		/		/		
	/		/		/		
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Blood pressure higher than 180/110 is an emergency. Call 9-1-1 immediately. If 9-1-1 is not available to you, have someone drive you to the nearest emergency facility immediately.

www.AmericanHeart.org/HBP

BLOOD PRESSURE TRACKER – WALLET CARD

INSTRUCTIONS:

American Heart Association
Learn and Live

- Take your pressure at the same time each day, such as morning or evening, or as your healthcare professional recommends.
- Sit with your back straight and supported and your feet flat on the floor.
- Your arm should be supported on a flat surface with the upper arm at heart level.
- Make sure the middle of the cuff is placed directly over your brachial artery. Refer to the Instructions page of this tracker for a picture, or check your monitor's instructions, or have your healthcare provider show you how.
- Each time you measure, take two or three readings, one minute apart, and record all the results.
- Cut this card out, fold it and keep in your wallet for use when you are traveling or away from home.

	BLOOD PRESSURE	HEART RATE (PULSE)
DATE/TIME		
READING 1		
READING 2		
READING 3		
COMMENTS		
DATE/TIME		
READING 1		
READING 2		
READING 3		
COMMENTS		
DATE/TIME		
READING 1		
READING 2		
READING 3		
COMMENTS		
DATE/TIME		
READING 1		
READING 2		
READING 3		
COMMENTS		

	BLOOD PRESSURE	HEART RATE (PULSE)
DATE/TIME		
READING 1		
READING 2		
READING 3		
COMMENTS		
DATE/TIME		
READING 1		
READING 2		
READING 3		
COMMENTS		
DATE/TIME		
READING 1		
READING 2		
READING 3		
COMMENTS		
DATE/TIME		
READING 1		
READING 2		
READING 3		
COMMENTS		

	BLOOD PRESSURE	HEART RATE (PULSE)
DATE/TIME		
READING 1		
READING 2		
READING 3		
COMMENTS		
DATE/TIME		
READING 1		
READING 2		
READING 3		
COMMENTS		
DATE/TIME		
READING 1		
READING 2		
READING 3		
COMMENTS		
DATE/TIME		
READING 1		
READING 2		
READING 3		
COMMENTS		

Blood pressure higher than 180/110 is an emergency. Call 9-1-1 immediately. If 9-1-1 is not available to you, have someone drive you to the nearest emergency facility immediately.

www.AmericanHeart.org/HBP

APPENDIX U: DISSERTATION DEFENSE ANNOUNCEMENT

Announcing the Final Examination of LTC MeLisa A. Gantt for the degree of Doctor of Philosophy
Date: June 29, 2010
Time: 10:30 am
Room: UT 328
Dissertation Title: The Effect of Simulated Combat Exercises on Cardiovascular Response: An Exploratory Study

Purpose: Hypertension (HTN) affects one in every three adults in the United States. Often associated with the older population, this silent killer has emerged in an unsuspecting group, young military soldiers. With the rapid succession of multiple deployments, long intervals between blood pressure (BP) assessments, and the absence of cardiovascular (CV) measures during the pre and post deployment health screenings; soldiers may be at higher risk for HTN than their civilian counterparts of the same age. The purpose of this study was to explore real-time continuous CV measures of soldiers before, during, and after exposure to a simulated combat stressor as well as to assess which personal characteristics played a significant role.

Methods: Applying the Allostasis/Allostatic Load theoretical framework, a repeated measure quasi-experimental design was used to compare the CV measures of two groups: one exposed to four hours of strenuous paintball and the other exposed to 45 minutes of a less intense combat stressor. A convenience sample of 60 college Army Reserve Officer Training Corps cadets were fitted with Tiba Medical Ambulo 2400 ambulatory BP monitors for 48 continuous hours. Several CV indices were analyzed using one-way Analysis of Variance (ANOVA), paired *t*-test, and independent sample *t*-test. Four instruments (Participant Information Sheet, State-Trait Anxiety Inventory, Paintball Perceived Stress Questionnaire, and Army Physical Fitness Test) were used to assess which characteristics played the most significant role in the CV response.

Results: Demographic characteristics between the two 30-cadet groups were not statistically different, with the exception of deployment history (experimental = 4, control= 0). Hours after the stress exposure, subjects in the experimental group had a higher mean awake systolic blood pressure (SBP) when compared to the control group (113.76 mm Hg vs. 102.98 mm Hg, *p*= 009). Significant bivariate correlations ($p < .05$) found that: *Females* consistently had higher pulse rates (PR) throughout each of the phases. *Age* positively correlated with elevated BP during the stressor, and increased morning BP surge post stressor. *African Americans* had higher sleep BPs pre stressor, and decreased SBP recovery post stressor; *Hispanics* had higher PRs during and after the stressor. *Waist circumference* positively correlated with elevated BP morning surge pre stressor but, *body mass index* (BMI) positively correlated with elevated BP morning surge post stressor as well as elevated BP during the stressor. *Family history of HTN* played no significant role; however, *deployment history* correlated with mean awake SBP post stressor. *Trait anxiety* scores negatively correlated with SBP recovery while s*tate anxiety* scores positively correlated with post stressor awake mean arterial pressure and evening SPB decline. Perceived stress during the stressor negatively correlated with post stressor SBP morning surge with females reporting higher anxiety and stress. Finally, *Army Physical Fitness (APFT) total scores* as well as *APFT run* scores negatively correlated with pre and post stressor sleep PRs.

Discussion/Implications: Age, female gender, African American descent, Hispanic ethnicity, waist circumference, BMI, previous deployment history, level of fitness, and the psychological stress state during and after a stressor played significant roles in soldiers' CV response. SBP was the most dynamic and informative of the CV indices. If paintball was enough of a stressor to produce residual CV effects that lasted well into following morning, the residual effect of a lengthy strenuous deployment may be alarming. This study not only provided a snapshot of the CV health of incoming young soldiers, but also provided evidence to support policy change regarding the implementation of regular CV health assessments before and after deployment.

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LIST OF REFERENCES

American College of Sports Medicine & American Heart Association (2007). Physical activity and public health: Updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation, 116*, 1081-1093.

American Heart Association (2010). *Target heart rates*. Retrieved on May 21, 2010 from http://www.americanheart.org/presenter.jhtml?identifier=4736

Anderson, C. A., & Dill, K. E. (2000). Video games and aggressive thoughts, feelings, and behaviors in laboratory and in life. *Journal of Personality and Social Psychology, 78*(4), 772-790.

Army ROTC (2009). *Army ROTC*. Retrieved on August 3, 2009 from http://www.goarmy.com/rotc/index.jsp

Barnes, V. A., Davis, H. C., Murzynowski, J. B., & Treiber, F. A. (2004). Impact of meditation on resting and ambulatory blood pressure and heart rate in youth. *Psychosomatic Medicine, 66*, 909-914.

Brain Sync (2010). *Brainwave therapy*. Retrieved on June, 1, 2010 from http://www.brainsync.com/home.html

Brookes, L. (2007). *The epidemiology of hypertension: Latest data and statistics.* Retrieved on June 16, 2008 from http://www.medscape.com/viewarticle/565720.

Burt V., Whelton P., Roccella E., Brown C., Cutler J., Higgins M., et al. (1995). Prevalence of hypertension in the U.S. adult population: Results from the Third National Health and Nutrition Examination Survey, 1988-1991. *Hypertension*, 25, 305-313.

Cacioppi, J. (1997). *MacArthur research network on SES and health: Modes of cardiac control*. Retrieved June 2, 2010, from http://www.macses.ucsf.edu/research/allostatic/control.php

Carretero, O. A., & Oparil, S. (2000). Essential hypertension: Part I: Definition and etiology. *Circulation, 101*(329-335).

Centers for Disease Control and Prevention (2009). *Healthy weight: About BMI for adults*. Retrieved February 1, 2010, from http://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/

Chida, Y., & Hamer, M. (2008). Chronic psychosocial factors and acute physiological responses to laboratory-induced stress in healthy populations: A quantitative review of 30 years of investigations. *Psychological Bulletin, 134*(6), 829-885.

Clark, M. S., Bond, M. J., & Hecker, J. R. (2007). Environmental stress, psychological stress, and allostatic load. Psychology, *Health & Medicine, 12*(1), 18-30.

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior, 24*, 385-396.

Conn, J. M., Annest, J. L., Gilchrist, J., & Ryan, G. W. (2004). Injuries from paintball game related activities in the United States, 1997-2001. *Injury Prevention, 10*, 139-143.

Covelli, M. M. (2006). The relationship of blood pressure and cortisol reactivity to family history of hypertension of African American adolescents. *Journal of Cardiovascular Nursing, 21*(5), 347-353.

Danziger, R. S. (2001). Hypertension in an anthropological and evolutionary paradigm. *Hypertension, 38*, 19-22.

Department of the Army (1998). *Physical fitness training (FM 21-20)*. Retrieved on August 1, 2009 from http://www.usma.edu/dpe/testing/fm21_20.pdf

Department of the Army (2006). *The army weight control program (AR 600-9).* Retrieved on January 5, 2010, from http://www.army.mil/usapa/epubs/pdf/r600_9.pdf

Deployment Health Clinical Center (2003). *DD 2795 primer: Pre deployment health assessment.* Retrieved on May 21, 2010 from http://www.pdhealth.mil/guidelines/downloads/DD_Form2795_Primer.pdf

Eisen, S. A., Kang, H. K., Murphy, F. M., Blanchard, M. S., Reda, D. J., Henderson, W. G., et al. (2005). Gulf War veterans' health: medical evaluation of a U.S. cohort. *Annals of Internal Medicine, 142*(11), 881-890.

Feldstein, C., & Julius, S. (2009). The complex interaction between overweight, hypertension, and sympathetic overactivity. *Journal of the American Society of Hypertension, 3*(6), 353-365.

Field, A. (2009). Discovering statistics with SPSS (3rd ed.). Thousand Oaks, CA: SAGE Publication, Inc.

Fisher, N. G., & Nicol, E. D. (2005). Cardiological disease in the armed forces: a clear and present danger. *Journal of Royal Naval Medical Service,* (91), 2.

Fisher, S., & Reason, J. (1988). *Handbook of life stress, cognition, and health*. New York: John Wiley & Sons.

Flachskampf, F. A., Gallasch, J., Gefeller, O., Gan, J., Mao, J., Pfahlberg, A., et al. (2007). Randomized trial of acupuncture to lower blood pressure. *Circulation, 115*, 3121-3129.

Florida Agency for Health Care Administration (2009). *Quality of care monitor program: Guidelines for the assessment and monitoring of pain*. Retrieved September 26, 2009 from http://www.fdhc.state.fl.us/mchq/Long_Term_Care/LTC/Misc/Guidelines_for_Pain_ 2002_2.pdf

Florida Department of Health. (2002) *Florida Chronic Disease Report 2002*. Retrieved July 1, 2008 from http://www.doh.state.fl.us/Family/chronicdisease/02ChronicDiseaseRpt.pdf

Florida Department of Health. (2007) *Cardiovascular Surveillance Summary 2007*. Retrieved July 1, 2008 from http://doh.state.fl.us/Family/Heart/PDF/cvd_surv_summ_2007.pdf

Forcier, K., Stroud, L. R., & Papandonatos, G. D. (2006). Links between physical fitness and cardiovascular reactivity and recovery to psychological stressors: A meta-analysis. *Health Psychology, 25*(6), 723-739.

Giles, T., & Izzo, J. (2008). The hemodynamics hypertension - The importance of pathophysiology and pharmacology [Electronic Version]. Retrieved May 20, 2008, from http://cme.medscape.com/viewarticle/574350

Granado, N., Smith, T., Swanson, G., Harris, R., Shahar, E., Smith, B., et al. (2009). Newly reported hypertension after military combat deployment in a large population-based study. *Hypertension, 54*(5), 966-973.

Gray, G., Reed, R., Kaiser, K., Smith, T., & Gastanaga, V. (2002). Self-report symptoms and medical conditions among 11,868 Gulf War-era veterans. *American Journal of Epidemiology, 155*(11), 1033-1044.

Grossman, A., Grossman, C., Barenboim, E., Azaria, B., Goldstein, L., & Grossman, E. (2006). Pre-hypertension as a predictor of hypertension in military aviators: A longitudinal study of 367 men. Aviation, Space, and Environmental *Medicine, 77*(11), 1162-1165.

Guyton, A., & Hall, J. (2006). *Textbook of medical physiology* (11th ed.). Philadelphia, PA: Elsevier, Inc.

Hales, D. (2009). *An invitation to health* (2009-2010 ed.). Belmont, CA: Wadsworth Cengage Learning.

Hoyt, R. W., Reifman, J., Coster, T. S., & Buller, M. J. (2002). *Combat medical informatics: Present and future.* Paper presented at the 2002 AMIA Annual Symposium: Biomedical informatics: One discipline, San Antonio, TX.

Izzo, J. W., Sica, D. A, and Black H. R. (2008). *Hypertension Primer: The essentials of high blood pressure basic science, population science and clinical management* (4^{th} ed). Philadelphia, PA: Lippincott Williams & Wilkins.

Janssen, I., Katzmarzyk, P. T., & Ross, R. (2002). Body mass index, waist circumference, and health risk. *Archives of Internal Medicine, 162*, 2074-2079.

Kaplan, N. (2003). Morning surge in blood pressure. *Circulation, 107*, 1347.

Kario, K., Pickering, T., Umeda, Y., Hoshide, S., Hoshide, Y., Morinari, M., et al. (2003). Morning surge in blood pressure as a predictor of silent and clinical cerebrovascular disease in elderly hypertensives: A prospective study. *Circulation, 107*, 1401-1406.

Kamarck, T. W., Everson, S. A., Kaplan, G. A., Manuck, S. B., Jennings, J. R., Salonen, R., et al. (1997). Exaggerated blood pressure responses during mental stress are associated with enhanced carotid atherosclerosis in middle-aged Finnish men: Findings from the Kuopio Ischemic Heart Disease Study. *Circulation, 96*(11), 3842-3848.

Kikuya, M., Hozawa, A., Ohokubo, T., Tsuji, I., Michimata, M., Matsubara, M., et al. (2000). Prognostic significance of blood pressure and heart rate variabilities: The Ohasama Study. Hypertension, 36, 901-906.

Khosh, F. (2001). Natural approach to hypertension. *Alternative Medicine Review*, 6, 590–600.

Lane, J. D., Kasian, S. J., Owens, J. E., & Marsh, G. R. (1998). Binaural auditory beats affect vigilance. *Physiology & Behavior, 63*(2), 249-252.

Larkin, K. (2005). Stress and hypertension: Examining the relationship between psychological stress and high blood pressure. New Haven: Yale University.

Lee, M., Lee, M. S., Kim, H., & Moon, S. (2003). Qigong reduced blood pressure and catecholamine levels of patients with essential hypertension. *International Journal of Neuroscience, 113*(12), 1691-1701.

Leicht, A. S., Hirning, D. A., & Allen, G. D. (2003). Heart rate variability and endogenous sex hormones during the menstrual cycle in young women. *Experimental Physiology, 88*(3), 441-446.

Lenfant, C., Chobanian, A. V., Jones, D. W., & Roccella, E. J. (2003). Seventh report of the Joint National Committee on the prevention, detection, evaluation, and treatment of high blood pressure (JNC 7): Resetting the hypertension sails. *Hypertension, 41*, 1178-1179.

Li, R., Alpert, B. S., Walker, S. S., & Somes, G. W. (2007). Longitudinal relationship of prenatal hypertension with body mass index, blood pressure, and cardiovascular reactivity in children. *Journal of Pediatrics, 150*, 498-502.

Light, K. C., Turner, J. R., & Hinderliter, A. L. (1992). Job strain and ambulatory work blood pressure in healthy young men and women. *Hypertension, 20*, 214-218.

Lloyd-Jones, D., Adams, R., Brown, T., Carnethon, M., Dai, S., DeSimone, G., et al. (2010). Heart disease and stroke statistics 2010 update: A report from the American Heart Association. *Circulation, 121*, e46-e215.

Matthews, K. A., Katholi, C. R., McCreath, H., Whooley, M. A., Williams, D. R., Zhu, S., et al. (2004). Blood pressure reactivity to psychological stress predicts hypertension in the CARDIA study. Circulation, 110(1), 74-78.

McArdle, W. D., Katch, F. I., & Katch, V. L. (1996). *Exercise physiology energy, nutrition, and human performance*. Philadelphia, PA: Williams & Wilkins.

McCauley, L. A., Lasarev, M. R., Sticker, D., Rischitelli, D. G., & Spencer, P. S. (2002). Illness experience of Gulf War veterans possibly exposed to chemical warfare agents. American *Journal of Preventive Medicine, 23*, 200-206.

McEwen, B. S. (1998). Protective and damaging effects of stress mediators. *New England Journal of Medicine, 338*(3), 171-179.

McGraw, L., Turner, B., Stotts, N., & Dracup, K. (2008). A review of cardiovascular risk factors in U. S. military personnel. *Cardiovascular Nursing, 23*(4), 338-344.

Mensah, G. A., & Brown, D. W. (2007). An overview of cardiovascular disease burden in the United States. *Health Affairs, 26*(1), 38-48.

Merriam-Webster's 11th Collegiate Dictionary (2003). Electronic version 3.0

Mertler, C. A. & Vannatta, R. A. (2005). Advanced and multivariate statistical methods: Practical application and interpretation (3rd ed.). Glendale: Pyrczak Publishing.

Millar, J. A., Lever, A. F., & Burke, V. (1999). Pulse pressure as a risk factor for cardiovascular events in the MRC Mild Hypertension Trial. *Journal of Hypertension, 17*(8), 1065-1072.

Minson, C. T., Halliwill, J. R., Young, T. M., & Joyner, M. J. (2000). Influence of the menstrual cycle on sympathetic activity, baroreflex sensitivity, and vascular transduction in young women. *Circulation, 101*, 862-868.

Morgan, C. A., Wang, S., Rasmusson, A., Hazlett, G., Anderson, G., & Charney, D. S. (2001). Relationship among plasma cortisol, catecholamines, neuropeptide Y, and human performance during exposure to uncontrollable stress. *Psychosomatic Medicine, 63*, 412-422.

Murray, K. (2004). *Training at the speed of life: The definitive textbook for military and law enforcement reality based training* (Vol. 1). Gotha, FL: Armiger Publications. National Center for PTSD (2008). Treatments for PTSD: Understanding the evidence. *PTSD Research Quarterly*, *19*(3), 1-11.

National Heart Lung and Blood Institute (2009) *What is blood pressure?* Retrieved February 3, 2009 from http://www.nhlbi.nih.gov/hbp/bp/bp.htm

National Heart Lung and Blood Institute (2010) *Classification of overweight and obesity by BMI, waist circumference, and associated disease risk.* Retrieved May 21, 2010 from http://www.nhlbi.nih.gov/health/public/heart/obesity/lose_wt/bmi_dis.htm

Neutel, J., Schumacher, H., Gosse, P., Lacouriere, Y., & Williams, B. (2008). Magnitude of the early morning blood pressure surge in untreated hypertensive patients: A pooled analysis. *International Journal Of Clinical Practice, 62*(11), 1654-1663.

O'Byrne, S., & Caulfield, M. (1998). Genetics of hypertension. *Drugs, 56*(2), 203-214.

Ong, K. L., Tso, A., Lam, K., & Cheung, B. (2008). Gender difference in blood pressure control and cardiovascular risk factors in Americans with diagnosed hypertension. Hypertension, 51(4), 1142-1148.

Oparil, S., Zaman, M. A., & Calhoun, D. A. (2003). Pathogenesis of hypertension. *Annals of Internal Medicine, 139*, 761-776.

Patel, P. V., Wong, J. L., & Arora, R. (2008). The morning blood pressure surge: Therapeutic implications. *Journal of Clinical Hypertension, 10*(2), 140-145. Redwood, H. (2007). Hypertension, society, and public policy. *European Heart Journal, 9*, B13-B18.

Raskind, M. A., Peskind, E. R., Hoff, D. J., Hart, K. L., Holmes, H. A., Warren, D., et al. (2007). A parallel group placebo control study on Prazosin for trauma nightmares and sleep disturbance in combat veterans with post-traumatic stress disorder. *Biological Psychiatry, 61*, 928-934.

Reckelhoff, J. F. (2001). Gender differences in the regulation of blood pressure. *Hypertension, 37*, 1199-1208.

Rodriguez-Roca, G. C., Alonso-Moreno, F. J., Garcia-Jimenez, A., Hidalgo-Vega, A., Llisterri-Caro, J. L., Barrios-Alonso, V., et al. (2006). Cost-effectiveness of ambulatory blood pressure monitoring in the follow-up of hypertension. *Blood Pressure, 15*(1), 27-36.

Rosamond, W., Flegal, K., Furie, K., Go, A., Greenlund, K., Haase, N., et al. (2008). Heart disease and stroke statistics-2008 update. *Circulation, 117*, e24-e146.

Sato, N., Miyake, S., Akatu, J., & Kumashiro, M. (1995). Power spectral analysis of heart rate variability in healthy young women during the normal menstrual cycle. *Psychosomatic Medicine, 57*, 331-335.

Sayk, F., Becker, C., Teckentrup, C., Fehm, H., Struck, J., Wellhoener, J., et al. (2007). To dip or not to dip: On the physiology of blood pressure decrease during nocturnal sleep in healthy humans. *Hypertension, 49*, 1070-1076.

Seals, D. R., DeSouza, C. A., Donato, A. J., & Tanaka, H. (2008). Habitual exercise and arterial aging. *Journal of Applied Physiology, 105*, 1323-1332.

Selye, H. (1974), *Stress without distress.* New York: New American Library.

Sesso, H., Stampfer, M., Rosner, B., Hennekens, C., Gaziano, J., Manson, J., et al. (2000). Systolic and diastolic blood pressure, pulse pressure, and mean arterial pressure as predictors of cardiovascular disease risk in men. *Hypertension, 36,* 801-807.

Smoley, B. A., Smith, N. L., & Runkle, G. P. (2008). Hypertension in a population of active duty services members. *Journal of American Board of Family Medicine, 21*(6), 504-511.

Spielberger, C. (1983) *State-Trait anxiety inventory for adults sampler set: Manual, test booklet, and scoring key*. Menlo Park, CA: Mind Garden, Inc.

Steptoe, A. (2000). Control and stress. In G. Fink (Ed.), *Encyclopedia of Stress* (2 ed., Vol. 1, pp. 526-531). San Diego: Academic Press.

Steptoe, A., & Marmot, M. (2005). Impaired cardiovascular recovery following stress predicts 3-year increases in blood pressure. *Journal of Hypertension, 23*(3), 529-536.

Stiles, S. (2007). NHANES: *Poor BP control rates among hypertensive with CV comorbidities* [Electronic Version]. Retrieved June 23, 2008, from https://www.medscape.com/viewarticle/567293

Stolarz, K., Staessen, J., & O'Brien, E. (2002). Night-time blood pressure: Dipping into the future? Journal of Hypertension, 20, 2131-2133.

Sudhir K, Jennings GL, Funder JW, Komesaroff PA. Estrogen enhances basal nitric oxide release in the forearm vasculature in perimenopausal women. *Hypertension.* 1996; 28:330 –334.

Tin, L. L., Beevers, D. G., & Lip, G. (2002). Systolic vs. diastolic blood pressure and the burden of hypertension. *Journal of Human Hypertension, 16*, 147-150.

Tiba Medical (2009) Ambulo 2400. Retrieved on March 1, 2009 from http://www.tibamedical.com

Trivedi, R., Sherwood, A., Straumand, A., & Blumenthal, J. A. (2007). Laboratory-based blood pressure recovery is a predictor of ambulatory blood pressure. *Biological Psychology, 77*(3), 317-323.

Tsai, J., Wang, W., Chan, P., Lin, L., Wang, C., Tomlinson, B., et al. (2003). The beneficial effects of tai chi chuan on blood pressure and lipid profile and anxiety status in a randomized controlled trial. *The Journal of Alternative and Complimentary Medicine, 9*(5), 747-754.

Tucker, A. M., Vogel, R. A., Lincoln, A. E., Dunn, R. E., Ahrensfield, D. C., Allen, T. W., et al. (2009). Prevalence of cardiovascular disease risk factors among national football league players. *Journal of the American Medical Association, 301*(20), 2111-2119.

Uchino, B., Holt-Lunstad, J., Bloor, L. E., & Campo, R. (2005). Aging and cardiovascular reactivity to stress: Longitudinal evidence for changes in stress reactivity. *Psychology and Aging, 20*(1), 134-143.

United States Army (2009). *Army Profiles (FY 09)*. Retrieved January 5, 2010 from http://www.armyg1.army.mil/hr/docs/demographics/FY09%20Army%20Profile.pdf

United States Army Medical Research and Material Command (2010). *Defense Women's Health Research Program (DWHRP)*. Retrieved on May 21, 2010 from https://momrp.amedd.army.mil/dwhrp_index.html

United States Department of Defense (2009). HA Policy 06-006: Periodic health assessment policy for active duty and selected reserve members. Retrieved on January 5, 2010 from http://www.ha.osd.mil/policies/2006/06-006.pdf

United States Department of Health and Human Services. (2004). The seventh report of the Joint National Committee on prevention, detection, evaluation and treatment of high blood pressure. Retrieved on June 9, 2008 from http://www.nhlbi.nih.gov/guidelines/hypertension/jnc7full.pdf

United States Government Accounting Office (2009). *Defense health care: Post-deployment health reassessment documentation needs improvement*. Retrieved on January 5, 2010. from http://www.gao.gov/new.items/d1056.pdf

Verdecchia, P., Schillaci, G., Borgioni, C., Ciucci, A., Gattobigio, R., & Porcellati, C. (1996). Nocturnal pressure is the true pressure. Blood Pressure Monitoring, S85-S85.

Ware, L. J., Epps, C. D., Herr, K., & Packard, A. (2006). Evaluation of the revised face pain scale, verbal descriptor scale, numeric rating scale and Iowa pain thermometer in older minority adults. *Pain Management Nursing, 7*(3), 117-125.

Weder, A. B. (2007). Evolution of hypertension. *Hypertension, 49*, 260-265.

World Health Organization (2003). 2003 World Health Organization (WHO)/International Society of Hypertension (ISH) statement on management of hypertension. Retrieved June 9, 2008 from http://www.who.int/cardiovascular_diseases/guidelines/hypertension_guidelines.pdf