EFFECT OF MULTIPLE ROLES ON AMBULATORY BLOOD PRESSURE IN WOMEN

By

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To the Faculty of Washington State University:

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The role of psychosocial risk factors for coronary heart disease (CHD) in women is not yet well understood. Stress has long been implicated as a risk factor for CHD. Conceptually, the common experience of women’s multiple roles may contribute to an increase in total stress burden, called background stress, due to conflicting demands and a more diffuse distribution of responsibilities between childcare, housework, and paid employment. The current study examined the relationship between multiple roles, background stress, and blood pressure in a sample of 102 women at a state university using partially latent structural regression analysis modeling. Results showed that being a mother in addition to being a student and/or employee was associated with higher levels of background stress ($\beta = .41, p = .002$). A trend between higher background stress and systolic baseline blood pressure was identified background ($\beta = .21, p = .06$); analyses did not reveal effects of background stress on ambulatory blood pressure. Follow-up linear regression analyses suggest that background stress is only predictive of higher resting blood pressure in mothers ($ps < .05$), though results should be interpreted with caution. Other significant direct and indirect effects within the models as well as implications and future directions are discussed.
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CHAPTER 1
INTRODUCTION

Coronary heart disease (CHD), the most prevalent form of cardiovascular disease, is the leading cause of death and disability among women in developed and developing countries (AHA, 2009). Traditionally considered a “man’s disease,” in the last three decades more US women than men have died of heart disease annually (Rosamond et al., 2007). Although women develop CHD later than men, once the disease manifests, women have no survival advantage over men. Moreover, women reportedly have higher mortality and morbidity rates than men following myocardial infarction (MI) (Alter, Naylor, Austin, & Tu, 2002; Vaccarino, Krumholz, Yarzebski, Gore, & Goldberg, 2001; Vaccarino, Parsons, Every, Barron, & Krumholz, 1999; Vaccarino et al., 2009). This difference is particularly evident in younger (<60-65 years) women as opposed to men, and young African-American women carry an excess share of these markedly higher MI mortality rates (Ho, Paultre, & Mosca, 2005; Rosamond, et al., 2007). In addition, women have lower functional gains and higher readmission, mortality and complication rates following coronary artery bypass graft surgery (Vaccarino et al., 2003; Wenger, Shaw, & Vaccarino, 2008). Women, especially younger women, are also less likely to enroll in and complete cardiac rehabilitation (Benz Scott, Ben-Or, & Allen, 2002; Marzolini, Brooks, & Oh, 2008), and Black women show the lowest enrollment rate and degree of improvement following rehabilitation (Allen, Benz Scott, Stewart, & Young, 2004; Sanderson, Mirza, Fry, Allison, & Bittner, 2007). Together these data suggest that there may be an underlying factor that may be able to account for these patterns in CHD risk, progression, and outcome.

Though overall CHD mortality rates have declined in the US, the reasons for this decline may differ in men and women. According to the National Heart, Lung, and Blood Institute (Bairey Merz et al., 2006), the decrease in CHD deaths in men is largely due to identification of risk factors, whereas for
women, CHD mortality decline is primarily due to advances in medical and surgical technology rather than identifying risk factors.

Women had long been excluded from the population considered at high risk for CHD and studies on risk factors, diagnosis, prognosis, and rehabilitation have largely focused on men (Beery, 1995; Fleury, Keller, & Murdaugh, 2000). Far less is known about CHD patterns in women. Men and women tend to share a number of traditional risk factors, such as smoking, hypertension, and hypercholesterolemia (e.g., Fleury, et al., 2000; Shaw et al., 2006; Yusuf et al., 2004) that account for a majority of the variance in CHD risk. However, a significant portion of CHD risk remains unexplained. Compelling evidence supports psychosocial factors as determinants of CHD development, progression, and morbidity and mortality in both men and women (Chida & Hamer, 2008; Everson-Rose & Lewis, 2005; Smith & Ruiz, 2002). The majority of the literature focuses on psychosocial CHD risk factors in men and findings have frequently been generalized to women, which is not always appropriate (Brezinka & Kittel, 1995; Orth-Gomér, Wenger, & Chesney, 1998; Shaw, et al., 2006). For instance, women have been shown to be significantly more sensitive to psychosocial factors including work content, workload and control, physical stress reactions, emotional stress reactions and burnout, as compared with men (Hallman, Burell, Setterlind, Odén, & Lisspers, 2001).

The association between psychosocial risk and incident CHD has been shown to be stronger in women than men (Hallman, et al., 2001; Thurston & Kubzansky, 2007). Overall observed trends in the literature suggest that women have a greater psychosocial risk burden than men (Wenger, et al., 2008). Moreover, psychosocial risk factors tend to co-occur more frequently among women and have an additive effect (Thurston & Kubzansky, 2007). For instance, low socioeconomic status (SES) has been linked to CHD incidence and mortality (e.g., Fiscella, Tancredi, & Franks, 2009; G. A. Kaplan & Keil, 1993) and studies indicate that low SES is more detrimental in women than men (G. A. Kaplan & Keil, 1993;
Thurston, Kubzansky, Kawachi, & Berkman, 2005). This relationship is particularly evident in single mothers, who may struggle financially, and have more coronary-prone lifestyle patterns including smoking, poor diet, lack of physical exercise, and higher levels of stress (L. E. Young, Cunningham, & Buist, 2005).

This paper reviews current literature to examine the effects of psychosocial factors, particularly chronic stress, on CHD risk in women. Further, a novel model of heart disease risk is proposed that identifies total stress burden or background stress resulting from the demands of multiple roles as an understudied source of stress that increases susceptibility to the development of CHD and may contribute to CHD trends noted in the literature. Finally, the model is tested on a sample of women at a state university using ambulatory blood pressure measures.

**Biological Pathways**

**Estrogen.** Women have a markedly lower incidence of CHD prior to the age of 50, after which time CHD rates increase and approach the rates of men by the eighth decade (Gordon, Kannel, Hjortland, & McNamara, 1978; Sytkowski, D'Agostino, Belanger, & Kannel, 1996). On average, women develop CHD 9 to 10 years later than men, a trend noted in populations around the world (Anand et al., 2008). The delay in CHD onset is generally believed to be due to the protective effect of estrogen on the vascular system in premenopausal women (Kannel & Levy, 2004; Mendelsohn, 2008; Schenck-Gustafsson & Al-Khalili, 1998). Estrogen benefits include favorable effects on lipid levels (increasing HDL and decreasing LDL cholesterol levels), activation of endothelial nitric oxide synthase leading to arterial vasodilation, and modulation of response to injury and atherosclerosis (Gilligan, Quyyumi, & Cannon, 1994; Guetta et al., 1997). In addition, estrogen exerts favorable influences on smooth muscle and endothelial cell function (Chen et al., 1999).
In spite of estrogen’s beneficial effects on the vasculature, it seems to merely delay rather than protect women from heart disease. Stress presents as an important variable in the estrogen-heart disease relationship. Studies in premenopausal monkeys suggest that chronic psychosocial stress induces ovarian impairment (Adams, Kaplan, & Koritnik, 1985; J. R. Kaplan et al., 1996), which is associated with exacerbated atherosclerosis in these females (J. R. Kaplan, Manuck, Anthony, & Clarkson, 2002; Williams, Shively, & Clarkson, 1994). Chronic stress may thus also be linked to ovarian impairment in women (J. R. Kaplan & Manuck, 2004), and stress-induced ovarian impairment in premenopausal women has been linked to increased CHD risk (Bairey Merz et al., 2003).

**Sympathetic Nervous System.** Physiologically, stress evokes a set of fight-or-flight responses that include rapid heart rate and increased respiration (Cannon, 1932). These responses are instrumental in ensuring an organism’s survival when faced with a threat. However, severe, prolonged stress leads to tissue damage and disease (Selye, 1956). One possible pathway linking chronic stress disease is physiological reactivity. The reactivity hypothesis suggests that larger, more frequent, and longer lasting physiological changes such as increased blood pressure may contribute to the development and progression of stress-mediated disease (Kamarck & Lovallo, 2003; D. S. Krantz & Manuck, 1984; Manuck, 1994).

**Allostatic Load.** The body’s ability to adapt to stressors and maintain homeostasis is adaptive over short term, but when the stressor is repeated or chronic, allostatic load can accelerate disease (McEwen, 1998). The cumulative burden of minor and major stressors that increase physiological arousal over time will result in wear-and-tear on the body. In addition to these stressors, a genetic loading combined with health behaviors calibrate one’s physiological response to adapt to daily living. A greater allostatic load, in turn, will result in a disproportionately more reactive and/or a prolonged response, thereby increasing the susceptibility to disease.
**Oxytocin.** Although the fight-or-flight stress response is widely accepted to explain physiological responses to stress in both men and women, an alternate “tend-and-befriend” profile seeks to explain the unique behavioral stress response in women (Taylor et al., 2000): When faced with stress, females nurture offspring (tend) and affiliate with a social group (befriend) to reduce risk. In addition, these affiliative responses to stress may be regulated via the release of oxytocin, a stress-buffering hormone. Therefore, in discussing the effects of stress on women’s cardiovascular health, it is imperative to include the traditional fight-or-flight response that may over time result in disease, and to also consider the role of social relationships.

**Psychological Pathways: Stress**

Biological factors are unable to account for the CHD mortality and morbidity trends noted in the literature, particularly those in younger women. It is possible that as younger, premenopausal women are protected against atherosclerotic cardiovascular disease compared with their male counterparts, a higher risk factor load is needed to overcome the protective effect of female gender. Research findings indicate that women with CHD have a higher prevalence of risk factors overall as compared to men (Wenger, et al., 2008). This difference in psychosocial risk burden is particularly pronounced among younger women with CHD who also show the highest excess mortality when compared with men.

A psychosocial factor that has consistently been linked with health outcomes is stress (e.g., Chida & Hamer, 2008; Segerstrom & Miller, 2004). Compared with other biological and lifestyle risk factors, stress is a more difficult construct in that no consensus exists with respect to either definition or measurement. The Transactional Model defines stress as one’s evaluation or appraisal of the perceived demands of the environment being greater than one’s perceived resources for coping with these demands (Lazarus & Folkman, 1984), thus positing a threat to the individual.
Different types of stress may be defined in terms of the duration of the stressor, the persistence of the threat or demand, and the duration of the response (Baum, Cohen, & Hall, 1993). Broadly speaking, stress can be acute or chronic. The initial stressor may be transitory or persistent, the appraisal of the stressor as threatening may be brief or prolonged (even if the actual stressor is absent), and psychological and physiological changes associated with stress may be short-lived or chronic. Most situations fall somewhere in between these extremes.

**Measuring Stress**

**Life events.** One approach to assessing stress is by measuring life events, major happenings that are both positive (such as a wedding) and negative (such as divorce), and require some degree of psychological adjustment. Examples of commonly used measures assessing life events are the Social Readjustment Rating Scale (SRRS; Holmes & Rahe, 1967), the Life Experiences Survey (LES; Sarason, Johnson, & Siegel, 1978), and the PERI Life-Events Scale (B. S. Dohrenwend, Krasnoff, Askenasy, & Dohrenwend, 1978). Stressful life events, especially when they cumulate over a relatively short period of time, are related to a wide variety of physical and mental illnesses (e.g., B. P. Dohrenwend & Dohrenwend, 1974; B. P. Dohrenwend et al., 1981). However, this approach has been criticized for issues such as psychometric problems, lack of representativeness of the sampled events among varying sociodemographic groups, and the absence of concern with psychological mediators such as the personal significance of events and the resources available to cope with them (Cohen, Kamarck, & Mermelstein, 1983; Hough, Fairbank, & Garcia, 1976; Lazarus & Folkman, 1984; Rabkin & Struening, 1976). Perhaps the most germane criticism of using life events as a measure of stress, however, has been that the relationship between life events scores and health outcomes has tended to be weak (e.g., de Faire & Theorell, 1977; Hinkle, 1974; Rabkin & Struening, 1976).
**Daily hassles.** An alternative to measuring major life events is assessing smaller events that occur more frequently, or hassles (Jandorf, Deblinger, Neale, & Stone, 1986; Kanner, Coyne, Schaefer, & Lazarus, 1981; Lazarus & DeLongis, 1983). Hassles are ongoing stresses and strains of daily living; the "irritating, frustrating, distressing demands and troubled relationships that plague us day in and day out" (Lazarus & DeLongis, 1983, p. 247). Minor hassles are thought to impact psychological and physical health via a cumulative effect that may wear down an individual. Also, minor events may interact with major life events or existing chronic stress to exacerbate distress and produce illness (Serido, Almeida, & Wethington, 2004). A commonly used measure of hassles is the Daily Hassles Scale (Kanner, et al., 1981). The research literature suggests that daily hassles are significantly related to psychological distress and symptomatology (Bolger, DeLongis, Kessler, & Schilling, 1989; Burks & Martin, 1985; Chamberlain & Zika, 1990; Kanner, et al., 1981; Kohn, Lafreniere, & Gurevich, 1991), and physical health or somatic problems, (DeLongis, Coyne, Dakof, Folkman, & Lazarus, 1982; DeLongis, Folkman, & Lazarus, 1988; Jain, Mills, von Kaelen, Hong, & Dimsdale, 2007; Twisk, Snel, Kemper, & van Mechelen, 1999). Unfortunately, the measurement of daily hassles is subject to some of the same criticisms as measurement of major life events (Hahn & Smith, 1999).

**Effect of Stress on Health**

The effects of stressors such as poverty, poor housing, and work conditions on the population’s health have long been noted by epidemiologists (Rosen, 1963). Compared with other major CHD risk factors, stress is complex, consisting of several different elements. Work-related stress is the most often studied source of chronic stress (Rozanski, Blumenthal, & Kaplan, 1999), and research findings indicate a strong association between this type of chronic stress and CVD, including atherosclerosis (Bosma, Peter, Siegrist, & Marmot, 1998; Lynch, Krause, Kaplan, Salonen, & Salonen, 1997) and predicting cardiac events (Aboa-Eboule et al., 2007; Karasek et al., 1988; Theorell et al., 1998). However, much of the
literature has focused on the effects of work stress on men’s cardiovascular health (Schnall & Landisbergis, 1994). In contrast to the relatively strong association between occupational stress and CHD risk among men, work stress is only moderately predictive of incidence and prognosis of CHD in women (Eaker, 1998; Eaker, Pinsky, & Castelli, 1992; Marmot, Bosma, Hemingway, Brunner, & Standfeld, 1997; Orth-Gomer et al., 2000; Wamala, Mittleman, Horsten, Schenck-Gustafsson, & Orth-Gomér, 2000).

**Job strain.** Karasek et al. (1981) posited the “job strain” model, in which work environments that are particularly demanding and allow for little control pose the most significant health risk. Literature supports a relationship between these high demand/low control work environments and increased risk for cardiovascular morbidity and mortality (Haynes, Feinleib, & Kannel, 1980; Karasek, et al., 1988; Kuper & Marmot, 2003; Lynch, et al., 1997; Marmot, et al., 1997; Steenland et al., 2000; Theorell, et al., 1998). However, some recent research findings are more mixed: Results from the Framingham Offspring Study (Eaker, Sullivan, Kelly-Hayes, D’Agostino, & Benjamin, 2004) show no association between job strain and CHD in men; instead, active job strain (high demand/high control) was linked to increased CHD risk in women. The investigators speculated that their findings may be a reflection of historical shifts in social status and roles for women in this cohort (mid-1980s), where breaking into traditional “men’s roles” of authority and control was met with opposition and social pressures that could have negatively impacted their cardiovascular health.

Even though the “job strain” model may not be as readily applicable to women as men, it has been suggested that the “job strain” model may be capturing important characteristics of an individual’s transactions with the environment that are not limited to the work environment, which may be associated with deleterious health effects. Some research findings support low control at home, not work, was a stronger predictor for anxiety and depression among women (Griffin, Fuhrer, Stansfeld, &
Marmot, 2002), and that low control at home was associated with increased CHD risk in women (Chandola, Kuper, Singh-Manoux, Bartley, & Marmot, 2004). A study examining the effects of daily experiences on carotid artery atherosclerosis in healthy adults found that participants reporting higher demands in daily life showed larger carotid intima-medial thickness (Kamarck et al., 2004). These findings were not limited to the workplace or to employed individuals, leading the authors to conclude that previous findings linking job stress to heart disease may, in fact, reflect the broader effect of daily psychological demands that are not necessarily limited to the workplace.

The chronic stress literature points to a gender pattern difference in stress source and cardiovascular health: Whereas occupational stress has been relatively consistently linked with CHD risk in men, other types of stress tend to be associated with heart disease risk in women (Everson-Rose & Lewis, 2005; Rosengren et al., 2004). Research examining physiological markers of stress supports the notion that men and women have different responses to sources of stress. Separate studies of employed men and women found a significant positive relationship between perceived stress and physiological responses at work in men but not women (Frankenhaeuser et al., 1989; Orth-Gomér, et al., 1998). This suggests that limiting stress measures to the effects of paid employment alone may not accurately capture women’s experience of stress or the physiological consequences of women’s stress burden.

**Non-Employment Related Sources of Chronic Stress and Health.** To date, relatively little research has examined the relationship between chronic, non-work-related daily life stressors and cardiovascular disease. In a longitudinal study of 73,000 initially healthy Japanese adults, women reporting high levels of non-specific daily life stress were nearly twice as likely to die of cardiovascular disease as women with lower stress levels (Iso et al., 2002). This association was not observed in men in the same study.
Caregiving. A specific source of non-work related chronic stress is caregiving. Caregiving has consistently been associated with adverse psychological and physical health outcomes (for reviews, see Etters, Goodall, & Harrison, 2008; Schulz & Beach, 1999; Schulz & Martire, 2004), including increased CHD risk in women (Lee, Colditz, Berkman, & Kawachi, 2003a, 2003b; Von Kaenel et al., 2008). Caregiving of elderly parents, ill spouses, or children, is more frequently the primary responsibility of women (Schulz & Martire, 2004) and women typically report a greater burden (Barusch & Spaid, 1989; Gallicchio, Siddiqi, Langenberg, & Baumgarten, 2002; Kramer & Kipnis, 1995; R. F. Young & Kahana, 1989) and experience more psychiatric morbidity attributable to caregiving than men (Covinsky et al., 2003; Yee & Schulz, 2000).

Marriage: A Source of Social Support or Chronic Stress?

Higher levels of social support have been linked with a number of health benefits (e.g., House, Landis, & Umberson, 1988; R. M. Kaplan & Kronick, 2006; Seeman, 1996), including protection against cardiovascular morbidity and mortality (e.g., Berkman, 1995; Rosengren, Wilhelmsen, & Orth-Gomér, 2004; Uchino, 2006). In men, social support has consistently been linked with decreased CHD risk (Brezinka & Kittel, 1995); however, research findings for women and social support have been mixed. For many adults, the marital relationship is a primary source of social support, and being married may be a health advantage by protecting against the well-documented risks associated with social isolation (e.g., Berkman, 1995; Berkman, Glass, Brissette, & Seeman, 2000; Brummett et al., 2001) and through the increased availability of socioeconomic resources (Lindström, 2009; Wyke & Ford, 1992). However, the findings concerning marital status and health have generally been less consistent for women than for men (for review, see Shumaker & Hill, 1991).

The relationship between social support and cardiovascular health seems to be more complicated for women than men. Emotional ties may be perceived as more stressful than supportive
by women, as they may be associated with both emotional distress and family responsibilities (Frankenhaeuser, Lundberg, & Chesney, 1991; Orth-Gomer, et al., 2000). Women are often the provider as well as the receiver of support, as both men and women tend to turn to women for support (Belle, 1987; Orth-Gomér & Chesney, 1997). Moreover, caretaking of children and elderly parents falls more frequently on women than men (Schulz & Martire, 2004). Therefore, social relationships may often come at a cost for women.

Research examining the role of the quality of the relationship may yield some insight into the inconsistencies in the social support literature. For instance, in a sample of male and female CHD patients, Coyne and colleagues (2001; 2006) found that poor marital quality was a better predictor of mortality in women than in men. In studies of self-reported health symptom severity in women with and without partners, women with supportive partners rated their health significantly better and experienced lower levels of psychological distress than those without a partner (Kostiainen, Martelin, Kestilä, Martikainen, & Koskinen, 2009; Reese, Somers, Keefe, Mosley-Williams, & Lumley, 2010); however, women with poor support from their partner reported poor health and showed more symptoms of psychological distress than women who had no partner at all. Rohrbaugh and colleagues (2006) found that poor marital quality was a better predictor of mortality in female rather than male CHD patients. Some research suggests that women are more sensitive than men to negative aspects of relationships. For example, women generally display more pronounced physiological responses to marital conflict when compared with men (Kiecolt-Glaser et al., 1997; Smith, Gallo, Goble, Ngu, & Stark, 1998).

In female coronary patients, work stress was unable to predict coronary events; however, long-term survival was poorer in those women who experienced high marital stress (Orth-Gomer, et al., 2000) and the combined effects of stress arising in both work and marital spheres was associated with
the worst health outcome (Orth-Gomér & Leineweber, 2005). Similarly, prolonged exposure to marital and work stress has been linked with progression in atherosclerotic narrowing in female coronary patients (Blom, Janszky, Balog, Orth-Gomer, & Wamala, 2003; Wang et al., 2007).

**Gender differences in stressor effects.** Findings in several studies suggest that there are gender differences in what is perceived as threatening that may affect the physiological stress response (Dedovic, Wadiwalla, Engert, & Pruessner, 2009). Women are typically less hemodynamically reactive than men to standard laboratory stressors, which tend to be performance-based (e.g., Kajante & Phillips, 2006; Kudielka, Buske-Kirschbaum, Hellhammer, & Kirschbaum, 2004; Light, Turner, Hinderliter, & Sherwood, 1993a, 1993b; Sarlo, Palomba, Buodo, Minghetti, & Stegagno, 2005) and more reactive than men to emotionally challenging tasks, such as accompanying a child to a routine doctor’s visit (Lundberg, de Château, Winberg, & Frankenhaeuser, 1981) or experiencing social rejection (Stroud, Salovey, & Epel, 2002). These differences in reactivity may translate outside the laboratory setting and suggest that women likely experience heightened reactivity to socially or emotionally challenging situations, such as balancing work and family life.

**Chronic Stress and Health in Women: An Interaction of Work and Family**

The research literature on physiological stress markers largely supports the notion that whereas men’s health is primarily associated with work-related stress, women’s health seems to be associated with an interaction of work and non-work stress. Whereas male employees’ self-reported stress was positively correlated with blood pressure (BP), catecholamine and cortisol levels at work, female employees tended to show the same elevations in stress markers at work when they showed similar stress-level elevations at home (Frankenhaeuser, et al., 1989). Further studies showed that women (especially management-level employees) had significantly higher norepinephrine levels after work compared to men’s sharp declines (Frankenhaeuser, et al., 1991), and that their physiological stress
levels were correlated between the work day and the evening at home (Lundberg & Frankenhaeuser, 1999). Particularly important in the interplay between work and home is the woman’s family situation. Whereas male employees with children report more time for relaxation and recreation after work, having children at home contributes to greater workload, less time for recreation, and higher norepinephrine levels in women (Luecken et al., 1997; Lundberg & Frankenhaeuser, 1999). This interdependence between stress from paid employment and unpaid work at home in women has also been illustrated in multiple studies carried out in different parts of the world, where an interaction between work and home stress was associated with increased burnout, greater total stress, increased role conflicts, and increased risk of psychosomatic strain and physical illness in women but not men (Aryee, 1993; Beena & Poduval, 1992; Greenglass, Pantony, & Burke, 1988; Gunilla Krantz, Berntsson, & Lundberg, 2005).

Multiple Roles

Interest in the relationship between social roles and health was provoked by women’s entry into the labor force in the 1960s, prompting the development of two opposing theories on the effect of multiple roles on health: The multiple attachment or role accumulation hypothesis and the multiple burden or role strain hypothesis. The role accumulation hypothesis posits that the combination of different roles benefit women’s health by providing women with more resources, including increased attachment to the community, higher self-esteem and sense of purpose, as well as financial independence (e.g., Arber, 1991, 1997; Barnett & Marshall, 1992; Bartley, Sacker, Firth, & Fitzpatrick, 1999; Hibbard & Pope, 1991; Lahelma, Arber, Kivelä, & Roos, 2002; Martikainen, 1995; Waldron, Weiss, & Hughes, 1998).

The role strain hypothesis, on the other hand, proposes that combining the competing demands and expectations associated with the roles of mother, partner, and employee lead to role strain and are
Background Stress: A Measure of Total Stress Burden

The aforementioned sources of stress underscore the notion that people rarely experience one stressor at a time; rather, they typically face a multitude of stressors of various durations and intensities. Stress from many sources combines to pose a stress burden, the sum total of ongoing hassles and major and minor stressors, past stressors, and anticipated future stressors. Research has shown that ongoing chronic stress or previous experience with stress can affect coping and consequences of current stressors, whether related or not, both psychologically and physiologically (for a review, see Gump & Matthews, 1999). For example, a study examining adolescents’ cardiovascular responses to four different acute stressor tasks showed that those reporting the highest levels of ongoing, chronic stress experienced exaggerated BP reactivity to all tasks compared with those reporting less ongoing stress (K. A. Matthews, Gump, Block, & Allen, 1997).

Background stress, a previously understudied source of stress, is the chronic stress burden that involves ambient stressors and minor daily hassles upon which new stressors may be superimposed. To date, a measure capable of accurately measuring the construct of background stress has not been available to researchers interested in examining the cumulative toll of minor stressors that potentially lurk in the “background” of people’s thought processes; however, the Background Stress Inventory (BSI) is currently being developed to capture this understudied source of stress.

Background Stress Model: A Conceptual Model of Heart Disease Risk

The Background Stress Model is proposed as an extension of the role strain hypothesis. In this model, the demands of women’s multiple roles contribute to a chronic underlying stress burden, or
background stress. This constantly present stress burden affects health either directly on psychophysiological processes or indirectly by influencing health-related behaviors (Gump & Matthews, 1999). See Figure 1.

**Women's Stress Burden**

Women tend to report a higher amount of stress and psychosocial load than men (Theorell, 1991). Role conflicts and work overload may create role strain and contribute to an increased stress burden for women (Berntsson, Lundberg, & Krantz, 2006; Frankenhaeuser, et al., 1991; Rodin & Ickovics, 1990).

To date, 68 million women are active members of the US labor force, comprising 46.5% of the total US labor force (Solis & Hall, 2009). But being equally involved in paid employment does not necessarily translate into equality in domestic gender roles. Women from dual career households continue to do a larger share of housework and childcare, and carry primary responsibility for these tasks (for a review, see Coltrane, 2000). National (Presser, 1994; Sayer, 2005; Thurston, Sherwood, Matthews, & Blumenthal, 2011) and international (Berntsson, et al., 2006; Davis & Greenstein, 2004; Evertsson & Nermo, 2004; D. Gjerdingen, McGovern, Bekker, Lundberg, & Wilemsen, 2000; Lothaller, Mikula, & Schoebi, 2009; Lundberg & Frankenhaeuser, 1999; Lundberg, Mårdberg, & Frankenhaeuser, 1994) studies have documented that women invest more time into family and household than their male counterparts and women report having the main responsibility for household duties and childcare. This difference in workload increases when children are present in the household (Lundberg, et al., 1994). In a study of 2,000 dual-earner US families, the time men and women devoted to housework and childcare was directly related to the number of children, especially young children, in the household (Kiker & Ng, 1990); but the impact of having a young child on workload was greater for the mother than the father.
Inequalities in workload that are linked with traditional gender roles may also be tied to problems in recovery after MI. Research suggests that female patients tend to ignore symptoms of overexertion and resume contraindicated physically demanding household chores such as vacuuming and doing the laundry within a shorter time period after hospital discharge than male patients (Hamilton & Seidman, 1993; Kristofferzon, Loefmark, & Carlsson, 2003; Lemos, Suls, Jenson, Lounsbury, & Gordon, 2003; G. L. Rose, Suls, Green, & Gordon, 1996). Women are also less likely to enter and more likely to withdraw from cardiac rehabilitation due to family obligations than other non-medical reasons than men (Halm, Penque, Doll, & Beahrs, 1999; Jackson, Leclerc, Erskine, & Linden, 2005; Marzolini, et al., 2008).

**Role perception.** Women’s experiences are more complex than the role attachment/role strain dualism implies. Recent research seems to suggest that in household where gender roles are more egalitarian, paid and unpaid workloads are more similar in men and women (Buunk, Kluwer, Schuurman, & Siero, 2000; Corrigall & Konrad, 2007; Nordenmark, 2004); however, this may be largely due to women reducing the amount of time spent on household chores rather than men increasing time spent on household chores (D. Gjerdingen, et al., 2000). It is possible that it is the quality, not mere quantity, of the social roles that mediates the relationship between roles and health. For example, Walters and colleagues (1998; 1997) found that time pressures in family roles, unappreciated work, and multiple competing demands were inversely related to health. Further, stress related to paid and unpaid work among women is influenced by attitudes toward housework and perceived fairness in distribution of housework, and discrepancies between attitudes or preferences and time spent on paid and unpaid work are associated with lower well-being and increased role strain (Boye, 2009; Claffey & Mickelson, 2009; Goldberg & Perry-Jenkins, 2004; Greenstein, 2009; Loscocco & Spitze, 2007).
Work vs. Family Roles and Health

The heavier total workload for women as compared to men is often referred to as one potential reason for women’s higher rate of ill-health (G. Krantz & Ostergren, 2000; Rosenfield, 1989). For many women, having both work and family roles is associated with higher levels of well-being (Marshall, 1997). For some women, however, the combined responsibility of work and family is associated with perceived increased time pressure and an inability to meet the demands of the various roles, which is associated with higher risk for depression and anxiety, fatigue, and poorer physical health (Brezinka & Kittel, 1995; Marshall, 1997; Pearlman, 1998). The notion that working women confront the dual burden of stress associated with their working lives and stress arising from their continued responsibilities in the home (i.e. household chores and childcare) has been referred to as the concept of the Second Shift (Hochschild, 1989).

Though health benefits have also been associated with the mother role (Fokkema, 2002; Khlat, et al., 2000; Martikainen, 1995), motherhood can be related to increased strain and psychological distress (Evenson & Simon, 2005; Kostiainen, et al., 2009; Luecken, et al., 1997; S. Matthews & Power, 2002), and the presence of children appears to heighten women’s risk for several physical disorders, including cardiovascular disease (Hardy, Lawlor, Black, Wadsworth, & Kuh, 2007; Haynes & Feinleib, 1980; Lawlor et al., 2003; Zhang et al., 2009). Under certain conditions, such as during the period after childbirth (D. K. Gjerdingen, Froberg, Chaloner, & McGovern, 1993) and when caring for small children while beginning an occupational career (Halpern, 2005; Lundberg, et al., 1994; Pavalko & Woodbury, 2000), more negative consequences may be associated with having a career and raising children.

The literature shows that multiple roles and paid work are associated with positive health outcomes (Artazcoz, Borrell, Benach, Cortès, & Rohlf, 2004; Khlat, et al., 2000; Kostiainen, et al., 2009; Lahelma, et al., 2002; Lundberg & Frankenhaeuser, 1999; Martikainen, 1995) and may protect women
from CHD (Brezinka & Kittel, 1995; Carson et al., 2009; Hazuda et al., 1986; Kritz-Silverstein, Wingard, & Barrett-Connor, 1992; K. M. Rose et al., 2004). However, the combination of employment and family appears to be associated with worse health outcomes (e.g., Arber, 1991; Arber & Lahelma, 1993; Lahelma, et al., 2002; McMunn, Bartley, & Kuh, 2006) and may enhance CHD risk (Brezinka & Kittel, 1995; Haynes & Feinleib, 1980; Theorell, 1991). Findings from the Framingham Heart Study indicated that the incidence of CHD over eight years was nearly twice as high in employed women with three or more children as in employed women without children (Haynes, et al., 1980).

**Caregiving burden, role strain, and health.** As previously discussed, caregiving is a source of chronic stress associated with adverse psychological and physiological health outcomes. The caregiving literature examining gender differences in caregiving burden seems to suggest that women are much more likely to assist with care provision tasks, to report work role strains, and to experience higher levels of burden than men (Kramer & Kipnis, 1995). Overall, a similar pattern in family and work stress interaction emerges in the caregiver burden literature as seen in the general stress burden literature. Studies have shown that employed caregivers report less caregiving strain and better psychological health outcomes (Dilworth & Kingsbury, 2005; Stephens & Townsend, 1997); however, Stephens and Townsend (1997) demonstrated that the stress related to providing care for an ill parent was aggravated by occupying three roles (i.e. mother, wife, and employee) in addition to being a caregiver. Similarly, a recent study examining the effects of caregiving for cancer survivors showed that whereas paid employment was generally beneficial for caregivers, employed caregivers who were also taking care of children reported higher levels of caregiving stress (Kim, Baker, Spillers, & Wellisch, 2006).

**Lone Working Mothers**

Lone mothers form a critical case, since they have fewer support and greater burdens, and therefore are expected to have poorer health. Studies throughout the world demonstrate that lone
mothers are at higher risk for physical and mental health problems and higher mortality rates compared to partnered mothers (Benzeval, 1998; Burstroem, Diderichsen, Shouls, & Whitehead, 1999; Curtis & Phipps, 2004; Lahelma, et al., 2002; Martikainen, 1995; Sarfati & Scott, 2001; Weitoft, Haglund, Hjern, & Rosen, 2002; Whitehead, Burstroem, & Diderichsen, 2000). Lone mothers are also at higher risk for heart disease (Higgins, Young, Cunningham, & Naylor, 2006; Weitoft, et al., 2002; L. E. Young, et al., 2005). The relationship between lone motherhood and increased disease and mortality risk may be in part due to the lower socioeconomic status in this population (Weitoft, Haglund, & Rosen, 2000; Westin & Westerling, 2007). A study comparing the health of lone mothers in Britain and Sweden, which has more favorable social policies and should protect lone mothers from poverty to a greater degree than the British equivalent, found that the health of lone mothers is as poor in Sweden as in Britain (Whitehead, et al., 2000). More notably, the difference between lone and partnered mothers was of a similar order in Sweden as in Britain; however, whereas in Britain poverty was a primary pathway to poor health outcome, the authors proposed that “time poverty” leading to increased stress was a potential pathway explaining poor health in Swedish lone mothers.

**Psychophysiological Mechanism of CHD: Cardiovascular Response to Stress**

Trends found in the research literature and presented herein largely lend support to proposed background stress model (Figure 1); multiple roles that often place conflicting demands on women may affect health outcomes through an increase in total background stress. Particularly working mothers who shoulder responsibilities of childcare, housework, and paid employment may be contending with this under-recognized stress burden that may contribute to the significant changes in CHD risk noted in this population.

**Ambulatory blood pressure.** A potential mechanism in the relationship between multiple roles, stress burden, and heart disease may be through an increase in cardiovascular and/or hemodynamic
responses to stress. Ongoing chronic stress can affect psychological and physiological responses to current stressors (Gump & Matthews, 1999); therefore, based on the model proposed herein, an increase in role demands and consequently background stress affects cardiovascular responses to new stressors, whether related or not.

Ambulatory blood pressure (ABP) has been shown to be an important independent cardiovascular risk marker in cross-sectional, prospective, and intervention studies (Pickering et al., 2007; Staessen et al., 2001; Verdecchia, 2000). Arguably, the value of ambulatory measures lies in their generalizability to daily life, their ability to capture lifestyle and behavioral influences that cannot be observed in a clinical or research lab setting (Kamarck, Polk, Sutton-Tyrrell, & Muldoon, 2002; Kamarck et al., 2005).

Prior research has shown an association between job strain and 24-hour ABP (Clays et al., 2007); however, similar to other research on job strain, findings have been less consistent in women than men (Riese, Van Doornen, Houtman, & De Geus, 2004). As noted previously, Kamarck and colleagues (2004) found that higher demands in daily life were associated with greater progression of atherosclerosis, and this relationship was partially mediated by daytime ABP (Kamarck, et al., 2004). These findings were not limited to the workplace or to employed individuals, suggesting that daily life demands may exert a potentially significant impact on cardiovascular health. Brisson and colleagues (Brisson et al., 1999) found that a combination of larger amounts of family responsibilities and job strain among white-collar women had a greater effect on 24-hour ABP than only one of these factors. A recent study (Thurston, et al., 2011) found that perceived responsibility for household tasks, not hours spent on these tasks, was associated with elevated ABP, and this was more pronounced in those men and women with lower incomes. The authors proposed that this observed interaction was likely due to the multiple stress sources acting synergistically to increase risk. Together, these findings suggest that stress from
multiple domains, such as may be associated with multiple roles, contributes to a total stress burden, which may negatively impact cardiovascular health.

**Current Study**

The current aims were to examine the relationship between multiple roles, background stress, and ambulatory blood pressure as proposed in the background stress model, and consider potential moderating factors, such as social support, within this relationship. Based on the literature reviewed above, hypotheses are as follows:

- **H1**: Working mothers report higher levels of background stress than working women without children.
- **H2**: Having young children in the household is associated with greater levels of background stress in working mothers.
- **H3**: Higher levels of background stress are associated with greater baseline blood pressure.
- **H4**: Higher levels of background stress are associated with greater ABP.
- **H5**: The relationship between multiple roles and baseline blood pressure is mediated by a prior relationship with background stress.
- **H6**: The relationship between multiple roles and ABP is mediated by a prior relationship with background stress.
- **H7**: Lower levels of social support are associated with greater baseline blood pressure.
- **H8**: Lower levels of social support are associated with greater ABP.
- **H9**: The relationship between multiple roles and baseline blood pressure is moderated by social support.
- **H10**: The relationship between multiple roles and ABP is moderated by social support.
CHAPTER 2
METHODS

Procedures

Participants reported to the lab (VCLS 160) between 8:00 and 8:30 a.m. Once initial informed consent was obtained, participants completed a set of questionnaires, including a demographics questionnaire, and measures of background stress and social support. Participants’ height and weight were taken. Following a 5 minute informational video about the blood pressure assessment portion of the study, a blood pressure cuff was placed on the upper portion of the participants’ non-dominant arm and participants completed a minimally involving task or “vanilla” baseline consisting of rating preference among 10 sets of two pictures at a rate of one set per minute (Jennings, Kamarck, Stewart, Eddy, & Johnson, 1992). Physiological data (BP, heart rate) was collected during the final 3 min and aggregated for an indicator of basal functioning using the same ambulatory blood pressure (ABP) monitor used for the remainder of the day to ensure instrument-based consistency between blood pressure measurement readings at baseline and throughout the day. At the conclusion of the baseline, the participant was handed a diary to be completed each time the ABP monitor takes a reading (every 45 min) and was asked to return to the lab between 4:30 and 5:00 pm.

Participation recruitment and exclusion. Participants were recruited through psychology courses and by advertising from the Washington State University Vancouver. Reminder emails were sent out with instructions the day before participating. The no-show rate for this study was relatively high (approximately 20%); no-shows were contacted through email to reschedule and a majority elected rescheduled and participated on the rescheduled date. Two participants refused to wear the ABP monitor; following these incidents, research assistants brought the ABP monitors with them for demonstration when recruiting to ensure participants knew what to expect. Two participants returned the ABP monitors early due to inclement weather and one participant returned the equipment early.
because she had to leave for work and was unable to return the monitor to the lab that day; all three participants had sufficient ABP data and were included in the analyses. With these exceptions, compliance was high. Exclusion criteria included major medical conditions or current use of medication that would affect BP. One participant was excluded from analyses because of medication use that affected her heart rate and blood pressure.

**Measures**

**Demographics.** Participants completed a questionnaire containing information on age, race/ethnicity, marital status, employment/academic status, presence and number of children in the household (including sexes and ages), smoking, medication, and exercise frequency.

**Background Stress Inventory (BSI).** A self-report 45-item measure that asks respondents to indicate how distressed they have felt by everyday life issues in five domains: personal/family (e.g., Unable to pay my bills), occupation/education (e.g., Work and/or school deadlines, arriving to work and/or school on time, appointments), environment (e.g., Living in a highly populated or congested area), health (e.g., Increasing health behaviors), and social (e.g., Finding the time to spend with loved ones). For each item, individuals were asked to rate their distress on a 9-point Likert-type scale (1 = no distress, 9 = extremely distressed) over the past month (acute) as well as for the majority of the past year (chronic). The developers of this measure intentionally sought to have respondents report their level of distress for different periods of time, in order to allow for the emergence of an actual “background stress” score. In doing so, the acute score is statistically removed by subtracting ($\sum 1$/reverse scored acute item) from the chronic item score.

At the time of this study, the measure was still under development. Exploratory factor analysis (EFA) was used to test psychometric properties of the measure on a sample of 521 participants. The EFA yielded five factors, with nine items per factor. The $\chi^2$–test of global fit was significant ($\chi^2(775) = 2014.38, p < .001$), indicating that the model predicted data are significantly different from the actual
data; however, the large sample size alone may produce significance and does not necessarily imply a poor fit (Brown, 2006). The Comparative Fit Index (CFI) = .875, Standardized Root-Mean-Square Residual (SRMR) = .037, and Root Mean Square Error of Approximation (RMSEA) = .05, which are all in the adequate range (Hu & Bentler, 1999). Internal consistency reliability analysis on a sample of 521 participants yielded a Cronbach’s alpha of .964 (Cronbach’s alpha for this sample was .925). The BSI is significantly correlated with a measure of perceived stressfulness (Perceived Stressfulness Scale; Cohen, et al., 1983), $r = .60, p < .001$. Previous applications of the BSI measure included various populations such as cancer patients, musculoskeletal pain patients, and healthy women. For example, in an ongoing study, preliminary findings indicated that women reported greater levels of overall background stress compared to men ($p < .01$). In addition, regression analysis indicated that in a sample of undergraduate women, the BSI was significantly predictive of depression, $p < .001$, and preliminary analyses in the same sample population of women showed that higher levels of background stress were significantly associated with increased diastolic blood pressure ($p < .05$), and marginally associated with increased systolic blood pressure ($p = .10$).

**Social support.** The Interpersonal Support Evaluation List (ISEL-12; Cohen, Mermelstein, Kamarck, & Hoberman, 1985) is a 12-item self-report measure of social support that consists of three independent subscales: “Appraisal” (perceived availability of someone to talk to), “belonging” (perceived availability of someone to do things with), and “tangible” (perceived availability of material aid) social support. Participants indicated how accurate each statement was about them on a 4-point Likert scale.

**Diary.** Participants were asked to complete a short questionnaire within 5-10 minutes of each ABP reading throughout the day containing time of day, what they were doing, if they were with someone, and how they were feeling right now. The PANAS (Watson, Clark, & Tellegen, 1988), a 20-item measure of positive (10 items) and negative (10 items) affect was used as a measure of current affect.
**Ambulatory blood pressure.** Baseline and ambulatory blood pressure were measured using Spacelabs ambulatory blood pressure monitors, model 90207 (Spacelabs Medical, Redmond, WA), an oscillometric device that had been validated in previous studies (Cates, Schlussel, & Pickering, 1990). If a measurement failed, the monitors were programmed to automatically retake the reading within a few minutes. All readings were reviewed and artifactual readings were discarded. If ABP readings were accompanied by error codes, then SBP, DBP, MAP, and HR readings were deleted for this reading. For non-error code readings, ABP in the following ranges were included in the analyses: SBP greater than 85 mmHg and less than 196 mmHg, DBP greater than 41 mmHg and less than 130 mmHg, HR greater than 45 bpm and less than 195 bpm. If either SBP or DBP was considered to be erroneous, the remaining readings for that time point were also removed from analyses. Each participant needed at least two valid ABP readings to be included in the analyses; 95% of participants had at least six valid readings. Ambulatory blood pressure readings were aggregated to obtain an average daytime ABP for each participant.

**Statistical Analyses**

Data was screened prior to analysis to identify potential sources of error. Frequencies were run for all physiological variables to check for data entry errors and potential outliers at baseline. The first step in identifying outliers was to identify any values outside 2 standard deviations of the group mean for a particular variable (e.g., baseline SBP < 95 mmHg or > 131 mmHg). The suspect value was then examined at the individual participant level.

Descriptive statistics as well as t-tests were obtained with SPSS statistical software. For all analyses, the level for rejection of the null hypothesis was set at $p < .05$, with $p < .10$ indicating a non-significant trend.

The background stress model (Figure 2, as discussed in the hypotheses) was evaluated with a partially latent factor structural regression analysis (SRA) using MPlus v.5.2 (Muthén & Muthén, 2007).
statistical software using the following steps: 1. Re-specifying the model as a measurement model and checking for identification; 2. Re-specifying the structural portion of the model as a path model and checking for identification; 3. Evaluating the measurement model (fit of measurement model must be good before proceeding to the final step); 4. Testing the SRA model. Both the measurement and partially latent SRA model used MLM estimation, or maximum likelihood parameter estimates with standard errors and a mean-adjusted chi-square test statistic that are robust to non-normality. Factors known to contribute independently to BP that could confound results (BMI, age) were added in to the model and then removed based on significance of predictive power. Although the focus of this paper was on evaluating the effects of multiple roles on ABP, background stress could potentially affect baseline blood pressure as well; thus, models were tested separately for ABP and baseline blood pressure outcome variables.

**Measurement model.** Confirmatory factor analysis was used to evaluate the measurement models. Scores from each of the three subscales of the ISEL, “appraisal,” “belonging,” and “tangible,” were used to create the latent factor “social support.”

**Partially latent structural regression model.** There is only one measure of the background stress construct, which when entered into the SRA assumes that “background stress” is free of measurement error. Alternatively, to account for measurement error within the background stress variable, this manifest variable was used to predict the latent factor “background stress” by fixing the value of measurement error variance based on a prior estimate (Kline, 2005). An estimate of measurement error variance was obtained by \((1 - \alpha)\sigma^2\). This transferred the reliable variance in the background stress manifest variable to the background stress factor. In this case, fixing the measurement error variance of the manifest variable “BSI score” to 148.82 [an estimate of measurement
error variance was obtained by \((1 - \alpha)s^2\) or \((1-.925)1984.21 = 148.82\] transferred 95.8% of the variance in the BSI manifest variable to the background stress factor.

**Variables.** In addition to the previously described social support, background stress, and blood pressure factors, the following variables were also included in the model:

**Multiple roles.** Multiple roles was defined as a dichotomous variable, 0 = student and/or employee who does not have children, 1 = student and/or employee who has children currently living at home.

**Young child.** The variable “young child” was defined as having a child under the age of 7 years old in the home (dichotomous variable, 0 = no child under age 7 years in the home, 1 = child under age 7 years in the home). This cut-off was based on prior research findings presented herein that suggests that having younger (not yet school-age) children in the home may be associated with more deleterious outcomes.

**Post-hoc analyses.** Linear regression analyses were used to examine the effect of background stress on baseline and ambulatory SBP, DBP, and MAP in mothers and non-mothers separately to further explore trends identified in the structural regression models. Independent samples t-tests were used to examine differences in background stress levels in subgroups of mothers (mothers of young children, lone mothers).
CHAPTER 3
RESULTS

Participant Characteristics

Participants included 102 adult women between the ages of 18 and 60 years ($M = 26.98$, $SD = 9.47$). Women who were mothers ($M = 32.11$, $SD = 9.05$) were on average significantly older than women who were not mothers ($M = 25.04$, $SD = 8.94$), $t(100) = .355$, $p = .001$. The sample was predominantly Caucasian (81.4%), with 7.8% participants identifying as Asian, 4.9% as Native American, 2.9% as Black, and 2.9% as Hispanic/Latina.

All participants ($n = 102$) were students (89.2% enrolled full-time). Sixty-three participants (62.8%) reported being employed; of these, 18.75% were employed full-time. Twenty-eight of the participants (27.5%) were mothers; the number of children in the household ranged from one to three, with 16 mothers having at least one young child under the age of seven in the household. Half ($n = 14$) of the mothers reported not having a spouse.

Multiple roles. Initially, participants were divided into three groups that were based on the roles they occupied: students, student mothers, and student mothers who were employed. One-way ANOVA indicated that these three groups were significantly different from each other with respect to BSI score, $F(2, 99) = 4.54$, $p = .01$; however, post-hoc analyses with Bonferroni correction indicate that there was no statistically significant difference between student mothers and student mothers who were employed. Therefore, only two groups were created for purposes of the structural regression model: mothers and non-mothers.

Physiological characteristics. The mean body mass index (BMI) for the sample was 25.72 ($SD = 5.85$). Three percent of the sample had a BMI in the underweight range (< 18.5), 54.5% in the normal range (18.5 – 24.9), 26.7% in the overweight range (25 – 29.9), and 15.8% in the obese range (> 30).
Body mass index of mothers ($M = 26.15$, $SD = 5.92$) did not significantly differ from BMI of women without children ($M = 25.56$, $SD = 5.86$), $t(99) = .451$, $p = n/s$.

Participants were normotensive or prehypertensive (baseline SBP < 140 mmHg, DBP < 90 mmHg). See Table 1 for mean sample baseline and ambulatory BPs and heart rates (HR). All baseline and ambulatory physiological indices (BPs and HRs) were statistically equivalent in mothers and women who are not mothers, $ts(97) < 1.80$, $p = n/s$.

**Evaluation of Models**

Mean and standard deviation statistics for model factors are presented in Table 1. Pearson correlation coefficients for all model factors are shown in Table 2.

**Evaluation of global fit for measurement models.** To evaluate global model fit, the $X^{2}$-test, Comparative Fit Index (CFI), Standardized Root-Mean-Square Residual (SRMR), and Root Mean Square Error of Approximation (RMSEA) were examined. For an ideal global fit, the $X^{2}$-test should be non-significant, the CFI > .95, and the SRMR and RMSEA < .06 (Hu & Bentler, 1999).

Overall, the baseline blood pressure measurement model has adequate global fit: the $X^{2}$-test of global fit is non-significant, $X^{2}(15) = 23.15$, $p = .08$, indicating that the model predicted data are not significantly different from the actual data. The CFI is .974, the SRMR is .052 and the RMSEA is .074, which are all in the acceptable range.

Similarly, the ambulatory blood pressure measurement model has good global fit: the $X^{2}$-test of global fit is non-significant, $X^{2}(15) = 20.45$, $p = .16$, indicating that the model predicted data are not significantly different from the actual data. The CFI is .981, the SRMR is .040 and the RMSEA is .061, which are all in the acceptable range.

In both measurement models, parameter loadings are meaningful (close to .7; Brown, 2006) and significant ($p < .001$). Factor correlations are less than .80, indicating reasonable discriminant validity in
both models. Furthermore, the model modification indices showed no areas where further changes to the models would be meaningful or could be theoretically justified.

Evaluation of Partially Latent SRA Models: Baseline Blood Pressure

Global fit. Overall, the partially latent structural regression model has good global fit. The $X^2$ test of global fit is non-significant, $X^2 (16) = 23.28$, $p = .17$, indicating that the model predicted data are not significantly different from the actual data. The CFI is .968, the SRMR is .053 and the RMSEA is .068, which are all in the acceptable range. See Figure 3 for partially latent structural regression model for baseline blood pressure.

Model parameters. Refer to Table 3 for effect decomposition.

Direct path coefficients. Analysis results support $H1$ that working/student women with children report higher levels of background stress ($\beta = .41$, $p = .002$) than working/student women without children; however, being a mother was not related to social support ($\beta = -.18$, $p = .26$), and did not directly predict baseline SBP ($\beta = -.01$, $p = .95$) or baseline DBP ($\beta = -.10$, $p = .50$). These findings indicate that for being a mother, there is a 37.77 point increase in background stress score, controlling for the prior effects of social support and having a young child in the home. Age ($\beta = .02$) and BMI ($\beta = .13$) were unrelated to background stress, $ps = n/s$.

Contrary to $H2$, analysis results indicate that having a child under the age of 7 years is not associated with higher levels of background stress; rather, there is a trend for increased background stress for not having young children in the home ($\beta = -.25$, $p = .06$). There is a 27.74 point increase in the background stress score for not having a child under the age of 7 years in the home. Having young children in the home is also not associated with social support ($\beta = -.08$, $p = .62$), and did not directly predict baseline SBP ($\beta = -.20$, $p = .26$) or baseline DBP ($\beta = -.05$, $p = .73$).
Analysis results show that higher levels of social support are associated with decreased levels of background stress ($\beta = -.43, p < .001$). These findings indicate that for every SD increase in social support there is a .43 SD decrease in background stress, controlling for the prior effects of being a mother and having a young child in the home on background stress. Being a mother ($\beta = -.18, p = .26$) or having a young child in the home ($\beta = -.08, p = .62$) were unrelated to social support.

Age significantly predicted baseline DBP ($\beta = .26, p = .02$) but not baseline SBP ($\beta = .02, p = .81$), and higher BMI was associated with higher baseline SBP ($\beta = .27, p = .003$) and baseline DBP ($\beta = .19, p = .04$). Therefore, for every SD increase in age, there is a .26 SD increase in baseline DBP, and for every SD increase in BMI, there is a .27 SD increase in baseline SBP and a .19 SD increase in baseline DBP. Analysis results showed a trend for higher levels of background stress being associated with higher baseline SBP ($\beta = .21, p = .06$) but not baseline DBP ($\beta = .10, p = .38$), partially supporting the expectation (H3) that higher levels of background stress are associated with greater baseline blood pressure. Therefore, for every SD increase in background stress, there is a .21 SD increase in baseline SBP, controlling for direct effects of BMI on baseline SBP. In addition, contrary to H7 that lower levels of social support are associated with greater baseline blood pressure, social support was unrelated to baseline SBP ($\beta = .01, p = .90$) and DBP ($\beta = .02, p = .84$). Because there is no association between social support and blood pressure, social support does not moderate the relationship between multiple roles and baseline blood pressure, thus rejecting H9.

**Indirect path coefficients.** Analysis results indicate a trend for the total indirect effect of being a mother to baseline SBP, $\beta = .10, S.E. = .06$. This indicates that for being a mother, there is a 2.04 mmHg increase in baseline SBP via its prior effects on background stress, $z = 1.68, p = .09$. Because the direct path from the mother role to baseline SBP is not significant, background stress fully mediates the relationship between mother role and baseline SBP. This partially supports the expectation (H5) that the
relationship between multiple roles and baseline blood pressure is mediated by a prior relationship with background stress.

Analysis results indicate a trend for the total indirect effect of social support to baseline SBP, $\beta = -0.09$, S.E. = .05, indicating that for every SD increase in social support, there is a .09 SD decrease in baseline SBP via its prior effects on background stress, $z = -1.67, p = .09$. Because the direct path from social support to baseline SBP is not significant, background stress fully mediates the relationship between social support and baseline SBP.

**Evaluation of Partially Latent SRA Model: Ambulatory Blood Pressure**

**Global fit.** Overall, the partially latent structural regression model has good global fit. The $X^2$-test of global fit is non-significant, $X^2 (16) = 20.50, p = .20$, indicating that the model predicted data are not significantly different from the actual data. The CFI is .977, the SRMR is .040 and the RMSEA is .053, which are all in the ideal range. See Figure 4 for partially latent structural regression model.

**Model parameters.** Refer to Table 4 for effect decomposition.

**Direct path coefficients.** Analysis results support $H1$ that being a mother in addition to being a student/employee is associated with higher levels of background stress ($\beta = .35, p = .01$); however, being a mother was not related to social support ($\beta = -.15, p = .33$), and did not directly predict ambulatory SBP ($\beta = -.04, p = .79$) or ambulatory DBP ($\beta = .01, p = .95$). These findings indicate that for being a student/working woman with children, there is a 31.38 point increase in background stress score, controlling for the prior effects of social support and having a young child in the home. Age ($\beta = -.01$) and BMI ($\beta = .09$) were unrelated to background stress, $p$s = n/s.

Contrary to $H2$, analysis results indicate that having a child under the age of 7 years is not associated with higher levels of background stress ($\beta = -.19, p = .15$). Having young children in the home
is also not associated with social support ($\beta = -0.09, p = .54$), and did not directly predict ambulatory SBP ($\beta = -0.07, p = .69$) or ambulatory DBP ($\beta = -0.11, p = .48$).

Analysis results show that higher levels of social support are associated with decreased levels of background stress ($\beta = -0.46, p < .001$). These findings indicate that for every SD increase in social support there is a .46 SD decrease in background stress, controlling for the prior effects of being a mother on background stress. Being a mother ($\beta = -0.15, p = .34$) as well as having a young child in the home ($\beta = -0.10, p = .54$) were unrelated to social support.

Age did not significantly predict ambulatory SBP ($\beta = .12, p = .33$) or ambulatory DBP ($\beta = .19, p = .09$), and BMI was also not associated with ambulatory SBP ($\beta = .13, p = .19$) or ambulatory DBP ($\beta = .04, p = .71$). Analysis results showed no effect for background stress on ambulatory SBP ($\beta = .13, p = .35$) and ambulatory DBP ($\beta = .13, p = .33$), which contradicts expectations ($H4$) that higher levels of background stress are associated with greater ABP. In addition, contrary to $H8$ (lower levels of social support are associated with greater ABP), social support was unrelated to ambulatory SBP ($\beta = .15, p = .29$) and DBP ($\beta = -0.03, p = .79$). Because there is no association between social support and blood pressure, social support does not moderate the relationship between multiple roles and ambulatory blood pressure, thus rejecting $H10$.

**Indirect path coefficients.** Analysis results indicate no significant indirect effects for this model; consequently, the relationship between multiple roles and ABP is not mediated by a prior relationship with background stress, rejecting $H6$.

**Post-hoc Analyses**

Linear regression analyses showed significant effects for background stress and baseline SBP ($B = .14 \pm .05, p = .01$) and baseline DBP ($B = .12 \pm .05, p = .02$) in women who are mothers; specifically,
mothers who have higher levels of background stress have higher baseline SBP and DBP. These effects remain significant if traditional risk factors (age, BMI) are entered into the model. There is no significant effect for background stress and baseline SBP or DBP in women who are not mothers. See Figures 5 and 6 for representations of the effects of background stress on baseline SBP in working women without and with children, respectively.

Linear regression analyses also indicate a trend for higher levels of background stress being associated with higher ambulatory DBP ($B = .07 \pm .04, p = .06$) in mothers; the trend remains if traditional predictors (age, BMI) are entered into the model. There is no trend observed for background stress and ambulatory DBP in women who are not mothers. Linear regression analyses also showed no significant relationship between background stress and ambulatory SBP for either group.

**Lone mothers.** Within the mother group, an independent samples t-test showed no significant differences in background stress, $t(26) = .65, p = .52$, between married mothers ($M = 139.45 \pm 43.99$) and lone mothers ($M = 149.40 \pm 36.16$). Linear regression analyses indicated that in lone mothers, higher levels of background stress significantly predicted higher baseline SBP, $B = .15 \pm .06, p = .03$; this relationship was not observed in mothers who were married, $B = .14 \pm .09, p = .13$. A trend was noted for higher levels of background stress being associated with higher levels of baseline DBP in both lone mothers, $B = .16 \pm .08, p = .05$, and mothers who were married, $B = .10 \pm .06, p = .10$. These observed effects persisted if traditional predictors (age, BMI) were entered into the regression. There were no significant effects for background stress and ambulatory blood pressure in lone or married mothers.

**Young children in the home.** Within the mother group, independent samples t-test showed no significant difference in background stress for mothers who have young children in the home ($M = 137.28, SD = 30.06$) as compared to those mothers who have no children under the age of 7 years in the home ($M = 153.92, SD = 41.80$), $t(26) = 1.10, p = .28$. 

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CHAPTER 4
DISCUSSION

The current study was able to establish a partially latent structural regression model for the relationship between multiple roles, background stress, and blood pressure, while considering the effects of social support, presence of young children in the home, and traditional predictors of blood pressure (age, BMI). The variables in both models were able to account for 32.5% of variance in background stress \( (p < .001) \). In addition, the baseline blood pressure model accounted for 17.2% of variance in baseline SBP \( (p = .009) \) and 15.9% of variance in baseline DBP \( (p = .007) \), leaving 82.8% and 84.1% of variance unaccounted for by model predictors, respectively. Variables in the ambulatory blood pressure model were unable to account for significant variance in ambulatory SBP \( (R^2 = .08, p = .17) \) and DBP \( (R^2 = .08, p = .16) \).

Consistent with expectations, multiple roles, specifically, being a mother in addition to being a student/employee, was associated with significantly higher levels of background stress. This finding supports (and extends) previously outlined literature findings that women who occupy multiple roles associated with school, work, and motherhood may contend with competing demands that contribute to a greater stress burden.

Contrary to prior research findings (e.g., Halpern, 2005), which suggest that caring for young children is associated with more negative consequences, the presence of young children (\(< 7\) years old) in the household did not have a significant impact on background stress in this participant population.

Although the background stress model was only able to identify trends for the relationship between multiple roles, background stress, and baseline blood pressure, follow-up regression analyses supported the hypothesis that higher levels of background stress are associated with higher levels of resting blood pressure and that this effect is specific to women who are mothers in addition to being students and/or employees. Importantly, this effect was more pronounced in lone mothers who
contend with the demands of the various roles on their own and thus may be particularly vulnerable to cardiovascular disease risk attributable to stress burden. The results of the post-hoc analyses should be interpreted with caution due to the small sample size of mothers (and even smaller sample of lone mothers); nonetheless, these findings provide an important starting point for future research in this area.

Surprisingly, background stress levels did not appear to have an effect on ambulatory blood pressure. There may be several reasons for this observed outcome. First, through the effects of allostatic load it is possible that as the body is exposed to a chronic, cumulative burden of major and minor stressors, it adapts to the challenge of the stress burden by increasing blood pressure to maintain homeostasis. Over time, this chronic physiological arousal produces wear and tear and is in effect raising resting blood pressure. Potentially, a greater allostatic load will result in a disproportionately greater and/or longer reactivity to and recovery from acute stressors, thereby increasing disease vulnerability. In addition, although the value of ABP measures lies in their generalizability to daily life, methodological issues may have interfered in effectively capturing the effects of allostatic load on cardiovascular reactivity to and recovery from stressors in this particular population. Specifically, timing and duration of ABP may not have encompassed all role obligations. Because ABP data collection was limited to the hours of 8 am – 5 pm, and all participants were students, a vast majority of the readings were obtained while participants were on campus. For women who are mothers, much of their stress burden originates from juggling demands of work, school, household chores and caring for children. Given the 8 am – 5 pm time frame of data collection, these mothers may not have had any interactions with their children and were likely not involved in all of these responsibilities; in fact, time at school may be less taxing and may offer a reprieve from the multiple stressors at home. Future research should extend data collection periods to include early mornings, when mothers are likely getting children (and themselves) ready for the day, as well as afternoons and evenings, when mothers are more likely to be involved in household
duties, preparing dinner, and helping children with homework while possibly working on their own work from school or place of employment.

It is interesting to note that women with children and those without children had statistically equivalent baseline blood pressures. The absence of a difference here suggests that although the effect of background stress on resting blood pressure is more pronounced in mothers than in women without children, there may be a potentially protective mediating factor involved. For example, student mothers may be more likely to engage in health-enhancing behaviors, such as exercise or a healthy diet. Future research should aim to identify these beneficial factors. Additionally, as previous research findings indicate, perceptions of greater responsibility for housework, unfair distribution of workload, feeling underappreciated, and not having adequate support, all may contribute to increased stress and role strain. A consideration for future work in this area may be looking at how women evaluate their roles and their lives in general using a measure of life satisfaction. This approach may allow insight into the qualitative nature of their stress burden source.

As noted in literature findings and suggested by post-hoc analyses herein, mothers who are not married may be particularly vulnerable to the effects of stress burden on cardiovascular health potentially due to having to shoulder demands of work and home on their own. In addition to expanding data collection to include a larger sample of lone mothers, it is important to extend this study to include unmarried fathers to determine if this background stress effect is particular to women or if it is common to single parents in general.

**Qualifications and Limitations**

The findings of this study need to be interpreted in the context of its limitations. Regarding the analyses, although structural regression analysis is able to model causal relationships, a cross-sectional design was used, thereby limiting the ability to predict future effects. In addition, ambulatory blood
pressure tends to vary within people throughout the day depending on factors such as body posture; therefore, mixed modeling analyses that examine differences within as well as between groups may produce a more comprehensive picture than average daily ambulatory blood pressure.

The use of a relatively healthy, young, predominantly Caucasian college sample limits generalizability and the findings may differ in persons of different races and/or ethnicities, age groups, and overall health status. The no-show rate for this sample was relatively high, perhaps due to the 8-8:30 am start time, and may have introduced bias; this particular time may have been early for students, and inconvenient for mothers who were likely dropping off school-age children around that time. In addition, as previously noted, the subsample of mothers was relatively small in comparison to women who are not mothers. Considering that follow-up analyses suggested significant effects for background stress on resting blood pressure in mothers only, this small sample size may have resulted in insufficient statistical power for significant effects in the baseline blood pressure model; however, the small sample size of mothers may also increase chance of error and thus the findings should be interpreted with caution. Future research should emphasize data collection from mothers; with adequate sample size, findings are more robust, and a more complex model may be developed.

**Conclusions**

Despite these qualifications, the present study contributes to the multiple roles literature and broadens understanding of the effects of multiple roles on blood pressure by developing and testing a model that introduces the understudied construct of background stress.

Several lines of data suggest that the growing incidence of heart disease in women and their increased risk for mortality due to heart disease are attributable to a confluence of factors. Together, these factors contribute to a gradually increasing vulnerability to heart disease, a process that may begin as early as in one’s 20’s-30s. Perhaps more so than any other developmental period, women are struggling to meet the competing demands of their multiple roles of job and family, which in turn, may
represent the basis for preventative interventions to address the potential influences on adverse health outcomes.
REFERENCES


### Table 1

**Descriptive Statistics for Model Variables**

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<th>Model Variables</th>
<th>Mean</th>
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**Baseline blood pressure (mmHg)**

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<th>Mean</th>
<th>SD</th>
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<td>SBP</td>
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**Ambulatory blood pressure (mmHg)**

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<td>MAP</td>
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<td>HR</td>
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**Psychosocial factors**

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<td>6.00 – 16.00</td>
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Table 2

*Pearson Correlations for Model Variables*

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<th>9.</th>
<th>10.</th>
<th>11.</th>
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<td>4. BMI</td>
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<td>10. Baseline DBP</td>
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<td>-.11</td>
<td>.30**</td>
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<td>.02</td>
<td>.79**</td>
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<td>11. Ambulatory SBP</td>
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<td>-.10</td>
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<td>.69**</td>
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<td>12. Ambulatory DBP</td>
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*p < .05, **p < .01
### Table 3

**Effect Decomposition for Baseline Blood Pressure SRA Model**

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<td>.410***</td>
<td>-.010&lt;sup&gt;ns&lt;/sup&gt;</td>
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<tr>
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<tr>
<td>Direct Effect</td>
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<td>-.252&lt;sup&gt;ns&lt;/sup&gt;</td>
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*<sup>p < .05; **p < .01; ***p < .005; ****p < .001</sup>
Table 4

*Effect Decomposition for Ambulatory Blood Pressure SRA Model*

<table>
<thead>
<tr>
<th>Causal Variables</th>
<th>Social Support</th>
<th>Background Stress</th>
<th>Ambulatory SBP</th>
<th>Ambulatory DBP</th>
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<tr>
<td><strong>Mother Role</strong></td>
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<tr>
<td>Direct Effect</td>
<td>-.151&lt;sup&gt;ns&lt;/sup&gt;</td>
<td>.345**</td>
<td>-.041&lt;sup&gt;ns&lt;/sup&gt;</td>
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*p < .05; **p < .01; ***p < .005; ****p < .001*
Figure 1. Background stress model. A conceptual model of heart disease risk in which demands of women's multiple roles contribute to a chronic underlying stress burden, or background stress, that may affect heart disease risk.
Figure 2. Partially latent structural regression analysis model.
Figure 3. Partially latent structural regression analysis model of the effect of multiple roles on baseline blood pressure via background stress.
Figure 4. Partially latent structural regression model of the effect of background stress on ambulatory blood pressure via background stress.
Figure 5. Post-hoc linear regression analysis of background stress and baseline blood pressure in women without children.
Figure 6. Post-hoc linear regression analysis of background stress and baseline blood pressure in women with children.